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REVIEW

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SERIES A.

Vol. 39. 1951.

LEJEUNE (R. R.). **The Effect of Jack-pine staminate Flowers on the Size of Larvae of the Jack-pine Budworm,** *Choristoneura* **sp.**—*Canad. Ent.* **82** no. 2 pp. 34–43, 2 figs., 11 refs. Guelph, Ont., 1950.

Young larvae of the form of *Choristoneura* [*fumiferana* (Clem.)] known as the jack-pine budworm are known to prefer staminate flowers [*R.A.E.*, A **35** 79, etc.] to foliage of jack pine [*Pinus banksiana*], though most of them migrate to the foliage after they have reached the fourth or fifth instar, and population records in Manitoba and north-western Ontario indicate that infestation of jack pine is invariably associated with an abundance of staminate flowers. The reasons for this were investigated in Ontario in 1943, and the findings regarding the influence of the jack-pine flowers on the growth of the larvae from the second (overwintered) instar onwards are here given. The following is substantially the author's summary. Head-capsule widths of both male and female larvae follow the laws of organic growth and increase in geometric progression. Theoretical values for the relative increase in width between successive instars (growth ratios) were calculated by four different methods, the most accurate being the method of least squares. Calculated regression lines gave the best, and, at the same time, a significant fit to the observed data. Head-capsule widths of the female larvae fall into discrete frequency distributions, permitting the classification of instars by this method, but in the case of the males, only those of the second, third, fourth and last instars fall into such distributions. Evidence indicates that about 50 per cent. of the male larvae pass through six instars, and the remainder through seven.

There is no significant difference between the overall growth coefficients of larvae gathered from staminate flowers and of those from foliage, calculated by the linear regression methods. The head-capsule widths of female larvae from staminate flowers were significantly greater than those of female larvae from foliage in the third, fourth and fifth, but not in the second, sixth or seventh instars. Those of male larvae from staminate flowers were significantly greater than those of male larvae from foliage in the third and fourth, but not the second or last instars. The remaining instars could not be properly segregated for statistical tests. The growth ratio of larvae occupying staminate flowers is greater than that of larvae feeding on foliage, but the gains are lost when the former migrate to foliage in the fourth and fifth instars. It is not known

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whether staminate flowers benefit the larvae by providing a more nutritious diet or a more favourable microclimate, or by a combination of both.

MORGAN (C. V. G.) & DOWNING (R. S.). **The Uses of Parathion in British Columbia Orchards.**—*Canad. Ent.* **82** no. 2 pp. 44–49. Guelph, Ont., 1950.

Parathion became available for experimental purposes in British Columbia in 1947, and accounts are given of tests in which sprays prepared from a wettable powder containing 15 per cent. parathion were applied against mites and insects in orchards. Except for the concentrated sprays, all spray quantities are per 100 gals. In 1947, two preliminary trials with 8 oz. powder were made against *Paratetranychus pilosus* (C. & F.) ; in the first, on apple in July, the average number of mites per leaf fell from 75·6 to 1·8 in 5 days and increased to 6·7 and 8·3 after a further 8 and 21 days, respectively, and in the second, on apple and pear, it fell from 58·3 to 0·2 in 4 days and increased to 3·6 and 24·7 after a further 15 and 30 days. In 1948, more extensive tests were carried out on apple, the materials being added to the regular summer sprays against the codling moth [*Cydia pomonella* (L.)], of which three were applied. Infestation by *Paratetranychus* was not heavy. Its numbers were estimated before and after each application and counts of winter eggs were made after the leaves had fallen. The results showed that the seasonal average numbers of mites per leaf and (in brackets) the numbers of winter eggs per inch of fruit spur were 19 (35·9) for no treatment, 4·5 (28·2) for 2 lb. parathion powder, 7·7 (581·6) for 1 lb. 50 per cent. DDT and 8 oz. parathion powder, 10·8 (377·7) for 8 oz. 50 per cent. DDT, 4 oz. parathion powder and 8 oz. polyethylene polysulphide adhesive [*cf. R.A.E.*, A **37** 308, etc.] and 5·4 (26·1) for 1 lb. 50 per cent. DDT, 5 oz. 40 per cent. dinitro-o-cyclohexylphenol and 1 oz. monoethanolamine. At harvest, the parathion residues were 0·045, 0·01 and 0·002 parts per million for the three parathion sprays, respectively. Tests on a smaller scale in other orchards gave similar results, and it was concluded that 8 oz. parathion powder in three summer sprays was required for commercial control, though the use of this amount led to the deposition of great numbers of winter eggs and commercial damage in the following spring, before the first cover spray was applied.

In 1949, 1 lb. 50 per cent. wettable DDT was included with all applications, and sprays were applied on 26th May, 13th June and 15th August. Mite populations were not recorded after the final application. The seasonal average numbers of mites per leaf were 4·6 for no treatment, 6·8 for DDT alone, 8·9, 2·3 and 0·6 for 4, 12 and 36 oz. parathion powder, 1·3 for 4 oz. parathion powder and 5 oz. 40 per cent. dinitro-o-cyclohexylphenol, 0·7 for 12 oz. parathion powder and 1 quart stove oil (viscosity 34 S.S.U.), and 1·6 and 3·6 for 5 oz. 40 per cent. dinitro-o-cyclohexylphenol with and without 1 oz. monoethanolamine, respectively. At harvest, the parathion residues were 0·18 and 0·02 p.p.m. for the sprays containing 36 and 12 oz. powder, respectively. Counts of winter eggs were not made, but large numbers were laid where 12 oz. parathion powder was used. Control of *Eriosoma lanigerum* (Hsm.) was very satisfactory. *Tetranychus pacificus* McG. was also controlled, but there are indications that *T. bimaculatus* Harvey may be producing parathion-resistant strains.

In other experiments over two years, parathion applied to apple in the pink stage gave better control of *P. pilosus* than either a dormant spray of 2 per cent. heavy oil (viscosity 200–220 S.S.U.) and 4 per cent. lime-sulphur or a first cover spray of parathion. Lime-sulphur is often applied at the pink stage, and a field experiment indicated that parathion can be applied with lime-sulphur

without losing its effectiveness. In 1949, parathion was applied to apple in the pink stage in three hand-sprayed orchards, all of which received two summer sprays of DDT, and mite populations were sampled two weeks and 1–4 months later. The results in all orchards were similar, and those of one, which are given, showed that the average seasonal numbers of mites per leaf were 16·19 for no treatment, 0·16, 0·06 and 0·02 for 12 oz. parathion powder alone, and with 1·25 gals. lime-sulphur or 6 lb. wettable sulphur, respectively, and 4·16 for 2 gals. dormant oil and 4 gals. lime-sulphur.

Results against *Eriosoma* were variable ; at least 1 lb. parathion powder was required for good control, and two applications in the regular DDT schedule against *C. pomonella* have given adequate summer control of this Aphid. If no treatment is applied until mid-summer and infestation becomes severe, one or more sprays at a higher concentration may be necessary. A concentrated spray applying 8 lb. parathion powder per acre gave excellent results, possibly partly owing to fumigant action, and did not necessitate such thorough wetting of the colonies as a conventional spray. The addition of 1–2 gals. stove oil increased the effectiveness of parathion against this Aphid. The addition of 36 oz. parathion powder to three cover sprays against *C. pomonella* failed to give appreciable control of *Aphis pomi* Deg. In a test against the mealy plum Aphid, *Hyalopterus arundinis* (F.), in which the sprays were applied on 25th May, the average numbers of Aphid colonies per tree on 18th June were 22 for no treatment, 0·3 for 12 oz. parathion powder and 6·8 for 0·75 pint nicotine sulphate and 3 lb. soap, but 12 oz. did not give satisfactory control of severe infestations. In 1949, similar experiments against *Myzus cerasi* (F.) on cherry showed that 12 oz. parathion powder applied in summer usually gave complete mortality and was better than the spray of nicotine sulphate and soap. The same concentration of parathion alone or with a heavy oil applied in the delayed dormant stage may be substituted for the current dormant spray of heavy oil and dinitro-o-cresol, and where no dormant spray is applied, a petal-fall application of parathion at the same rate has proved adequate.

A concentrated spray of parathion powder applied at 7 lb. per acre to peach when most of the petals had fallen was as effective against *Lygus* spp. as 15 lb. 50 per cent. DDT, and parathion powder applied at 8 lb. per acre as a concentrated spray or at 1 lb. per 100 gals. by the conventional method to peach at the pink stage gave promising control of *Anarsia lineatella* Zell. When dormant oil and lime-sulphur were applied with a steam generator with a blower against *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.) on prune, the percentage of fruit infested at harvest was 0·3, as compared with 35·2 for parathion powder at 6 lb. per acre applied on 10th June with the same machine. An early summer spray of 12 oz. parathion powder readily controlled the pear psylla, *Psylla pyricola* Först., in most orchards, and the same concentration, applied when the larvae were nearly mature, gave complete mortality of a severe infestation of *Spilonota ocellana* (Schiff.) on cherry, benzene hexachloride, DDT, nicotine sulphate and hexaethyl tetraphosphate proving unsatisfactory.

The McIntosh variety of apple has been injured by parathion in eastern Canada, but no damage to this or other varieties has been recorded in British Columbia from conventional sprays of parathion applied as early as the pink stage. In one orchard, however, the foliage and fruit on the lower branches of McIntosh were injured by a concentrated spray. Parathion emulsion applied as a concentrated spray has severely damaged apple and pear and is not recommended for use in Canada. Wherever both parathion and DDT have been used in British Columbia, most beneficial insects appear to have been completely destroyed. No fatalities have occurred in British Columbia from the use of parathion although many cases of illness have resulted from the application of concentrated sprays without an adequate respirator.

Sullivan (C. R.) & Green (G. W.). **Reactions of Larvae of the Eastern Tent Caterpillar,** *Malacosoma americanum* **(F.), and of the Spotless Fall Webworm,** *Hyphantria textor* **Harr., to Pentatomid Predators.**—*Canad. Ent.* **82** no. 2 p. 52. Guelph, Ont., 1950.

Nymphs and adults of the Pentatomids, *Podisus placidus* Uhl. and *P. modestus* (Dall.) were frequently observed during field studies in Ontario to visit colonies of *Malacosoma americanum* (F.) and occasionally those of *Hyphantria textor* Harr. and attack the larvae. Instances were noted in which *Malacosoma* larvae in the fifth and sixth instars webbed the predators into the structure of the tent so that they could not escape, and one in which a late-instar larva of *Hyphantria* seized a Pentatomid in its mandibles and dropped it outside the web.

Oman (P. W.). **The Nearctic Leafhoppers (Homoptera : Cicadellidae) a generic Classification and Check List.**—*Mem. ent. Soc. Wash.* no. 3, $10\frac{1}{4} \times 6\frac{3}{4}$ ins., [7+] 253 pp., 44 pls., 4 pp. refs. Washington, D.C., 1949. Price $7.

The main part of this work is a revision of the classification of the Jassids of America north of Mexico. It comprises keys to the subfamilies, tribes, genera and subgenera represented in the region, and descriptions of the characters of the subfamilies and tribes, and of the adults and, in many cases, the nymphs of each genus, with summaries of the synonymy and distribution of the genera and lists of the species with indications of their distribution. The genera, over 50 of which are new, are grouped in 18 subfamilies and 31 tribes ; two new species are described. There are also brief introductory sections on the taxonomy and morphology of Jassids and their bionomics, food-plant relations, economic importance, parasites and distribution, and on the preparation of specimens for taxonomic work. The section on economic importance, which is the longest, is mainly concerned with a review of the relation of Jassids to virus diseases of plants throughout the world and includes a list of the species concerned, showing the viruses they transmit.

Lesser (M. A.). **Moth Products.**—*Soap & sanit. Chem.* **25** no. 3 pp. 133, 135, 137, 143 ; no. 4 pp. 133, 135, 137, 149, 155, 4 figs., 46 refs. New York, N.Y., 1949.

In this review of methods of protecting woollen fabrics, the author discusses the damage caused in the United States by clothes moths, chiefly *Tineola bisselliella* (Humm.) and *Tinea pellionella* (L.), and rarely *Trichophaga tapetzella* (L.), and describes their life-history. He points out that much damage erroneously attributed to them is caused by carpet beetles [*Attagenus piceus* (Ol.) and *Anthrenus* spp.] and that the larvae of both moths and beetles often occur together, so that it is necessary to protect wool from both.

Mechanical methods include the brushing, shaking, beating, airing and sunning of susceptible fabrics. Cold storage prevents damage, and dry-cleaning or washing in a strong solution of neutral soap kills all moth stages present, but does not impart resistance. Fumigants used against clothes moths include naphthalene, cedar products, camphor and paradichlorobenzene. The value of different combinations of these and various adjuvants is discussed in some detail.

Compounds used as stomach poisons for moth-proofing include inorganic fluosilicates which are resistant to dry-cleaning but not to laundering, cinchona alkaloids, which are removed by dry-cleaning but not by washing, and aluminium fluoformate ; when this is applied to a fabric and heated, it produces

aluminium fluoride, which is insoluble in water and dry-cleaning solvents, but liberates formic acid. The Eulans, which are generally used as part of the textile processing, enter the wool fibres like acid dyes and are colourless and resistant to washing, dry-cleaning and light. Eulan CN (the sodium salt of pentachlorodihydroxytriphenylmethane-sulphonic acid) protects materials from clothes moths when added to the dye bath at the rate of 1·5 per cent. of the weight of cloth to be treated and against carpet beetles when used at 2 per cent. Mitin FF is said to be a substituted urea containing a dichlorodiphenyl ether and a sulphonic group and also gives commercially permanent protection when applied to the fabric from the dye bath. The Mystoxes are said to be protein-pentachlorophenol and protein-laurylpentachlorophenol complexes and have the advantage of being applicable at any stage of wool processing. They appear to form a complex with the wool, with the result that the pentachlorophenol has no odour and is permanent in wear.

DDT has proved effective as a contact poison when applied at certain stages in processing or during dry-cleaning, when sprayed on the materials and in cupboards where they are stored, or when applied in warehouses in thermal aerosol fogs. Other effective poisons include rotenone and pyrethrum, benzene hexachloride, chlordan and toxaphene.

In the newest method of protecting fabrics from clothes moths, the structure of the wool fibre is altered without impairing its physical properties. The larvae digest wool only after breaking its disulphide cross linkages by means of reducing agents present in their intestinal tracts, and these cross linkages can be strengthened or rearranged to make them more resistant to this digestive action. One method of achieving this was by reducing the disulphide linkages in wool with thioglycolic acid or other mercaptans and then reconstructing the cross linkages by a reaction with alkylene dihalides. Wool thus treated was much more resistant to moth attack and also to alkalis, reducing agents and oxidising substances than untreated wool, but the method proved too expensive for industrial use. It has proved more economical to employ a single process in which hydrosulphite reduces the cross-links, and formaldehyde, glyoxal or alkylene dihalides reconstitute the structure ; the reconstituted wool is resistant to moths, alkalis, and oxidising and reducing agents. A patented material (Boconize) is reported to act chemically as an acid salt of an aromatic amine, reacting with the disulphide linkage in the fibre to make it unpalatable to the larvae, and to withstand as many as 25 dry-cleanings and five washings. Another patented product (P.M.C. 50) appears to be a nitrogenous material that protects wool against moth damage and is capable of withstanding 20 dry-cleanings and 4–5 launderings.

DE ONG (E. R.). **Chemistry and Uses of Insecticides.**—$9\frac{3}{4} \times 6$ ins., viii+345 pp., 18 figs., many refs. New York, N.Y., Reinhold Publ. Corp., 1948. Price $6.

This work has already been reviewed [*R.A.E.*, A **37** 142], but the copy submitted for review lacked the last 18 pages. A complete copy has now been received and, unlike the defective one, includes an index to subjects as well as to authors.

LEHMAN (A. J.). **Toxic Actions of Insecticides.**—*Soap & sanit. Chem.* Blue Book 1949 pp. 173–175. New York, N.Y., 1949.

This is a review of information on the toxicity to mammals, mainly man, of derris, pyrethrum, nicotine, aliphatic thiocyanates (Lethanes), DDT, methoxy-DDT (methoxychlor), DDD [dichlorodiphenyldichloroethane], chlordan, benzene hexachloride, toxaphene, tetraethyl pyrophosphate and parathion.

NOLAN (K.) & WILCOXON (F.). **Method of Bioassay for Traces of Parathion in Plant Material.**—*Agric. Chem.* **5** no. 1 pp. 53, 74, 3 refs. Baltimore, Md., 1950.

Since it has been shown that parathion can be absorbed by the root systems of young plants from soil containing high dosages and translocated to render the leaves and stems toxic to insects for a certain time [*cf. R.A.E.*, A **37** 300 ; **38** 234], a bioassay method was developed to estimate small amounts of parathion in or on plant tissue. In view of their extraordinary sensitivity to parathion, mosquito larvae were selected as test insects.

Preliminary tests with water suspensions of macerated plant tissue against larvae of *Aëdes aegypti* (L.) indicated that many were toxic to the larvae in the absence of parathion, but it was later found that benzene extracts of macerated tissue from treated plants contained 80–90 per cent. of the parathion originally present, whereas such extracts from untreated plants were mainly non-toxic to the larvae. A satisfactory method was therefore developed, based on comparison of a dosage-mortality curve obtained by diluting a standard solution of parathion to which untreated plant extract had been added and one obtained by diluting an extract of treated plant tissue, each cc. of which represented a known amount of plant material. Dividing the median lethal dosage obtained from the first curve by that from the second gave the content of parathion in the tissue in parts per million when the first was expressed in mmg. parathion per beaker and the second in gm. plant material per beaker. The addition of extract of untreated plant tissue to the standard parathion solution was found to be necessary because the presence of plant extract slightly reduced the toxicity of the parathion. When the sample was so low in toxicity that a value for the median lethal dosage could not be obtained, it was possible to calculate an upper limit for the parathion content by dividing the median lethal dosage of the standard by the largest value for the plant tissue used. Experience indicates that the method is suitable for concentrations of parathion as low as 0·02 part per million in most plants, but it is useless for material that may have been treated with more than one insecticide and difficulty was found with some plant tissues, such as shelled peas and potato tubers, owing to the toxicity of the benzene extracts of untreated material.

The preparation of the sample and the parathion standard is described in some detail. Treated plant material (100–200 gm.) was macerated in a Waring blendor with an equal weight of water and the resulting suspension extracted with benzene to give a final concentration equivalent to 1 gm. sample per cc. solution. Various amounts of this solution were pipetted into beakers, the benzene was evaporated with an air jet, and the residue was dissolved in 0·5 cc. acetone and made up to 25 cc. with water. Another 25 cc. water containing ten three-day-old larvae of *A. aegypti* was added, and the beaker was covered with a watch glass and allowed to stand for 40 hours, after which counts of dead larvae were made. The inability of submerged larvae to rise to the surface was used as the criterion of death. Three beakers were used for each concentration, and the results were plotted on logarithm-probability paper. A benzene extract equivalent to 1 gm. untreated plant material per cc. was prepared in the same way, and 1 cc. of a 0·000125 per cent. solution of parathion in benzene was added to each 24 cc. to give 0·0521 mmg. parathion per gm. plant material. Various amounts of the standard solution were pipetted into beakers to provide 0·025–0·15 mmg. parathion per beaker, and the benzene was evaporated and the final solutions prepared and tested as before.

The method gave results closely approximating those obtained by chemical analysis, the amounts of parathion in parts per million being estimated as 0·10 for green onion bulbs three months after the sets were planted in soil containing 100 lb. parathion per acre, 0·20 for potato foliage two months after planting

in soil also containing 100 lb. parathion per acre, and 0·16 for maize foliage one month after planting in soil containing 25 lb. parathion per acre, as compared with 0·11, 0·30 and 0·16, respectively, for chemical analysis.

MAGEE (W. J.) & GAINES (J. C.). **Toxicity of Phosphorus Compounds to various Insects.**—*J. econ. Ent.* **43** no. 3 pp. 281–286, 1 fig., 5 refs. Menasha, Wis., 1950.

The results are given of insecticidal tests, carried out in Texas in 1949, in which seven new phosphorus compounds, some of which had proved much less toxic to the higher animals than parathion or tetraethyl pyrophosphate, were compared with parathion and, in some cases, toxaphene, in dusts. The new compounds, referred to by code numbers, were 3885 (S-mercaptoacetylurea O,O-diethyl dithiophosphate), 3677 (O,O-diethyl O-2-chloro-4-nitrophenyl thiophosphate), 3700 (S-tert.-butyl mercaptomethyl O,O-bis-(2-chloroethyl) dithiophosphate), 3456 (O,O-diisopropyl O-p-nitrophenyl thiophosphate), 3741 (S-carbamylmethyl O,O-diethyl dithiophosphate), 3869 (S-carbamylmethyl O,O-dimethyl dithiophosphate) and 3901 (S-mercaptoacetylurea O,O-dimethyl dithiophosphate) [also known as O,O-dimethyl S-(2-oxo-2-ureidoethyl) dithiophosphate (*cf. R.A.E.*, A **38** 431, 498)]. Dusts were prepared by dissolving the practically pure technical compounds in acetone and spraying the solution on pyrophyllite in a revolving drum to give a 10 per cent. concentrate, which was diluted with pyrophyllite as necessary. In cage tests, parathion was more toxic to nymphs of *Melanoplus differentialis* (Thos.) than any of the other phosphorus compounds when they were applied in 2 per cent. dusts at 6–12 lb. per acre as contact or stomach poisons, and 5 per cent. parathion and 20 per cent. toxaphene at 12 lb. per acre gave effective control of larvae of *Heliothis armigera* (Hb.) caged on cotton, whereas the new compounds were inadequate in 5 per cent. dusts and in some cases gave even less control at 10 per cent., possibly owing to repellent action. Dusts containing 2 per cent. 3677 or 3700 were as toxic as 2 per cent. parathion at the same rate (8 lb. per acre) against adults of *Psallus seriatus* (Reut.) confined on dusted cotton plants, and 5 per cent. 3677 at 25 lb. per acre gave 74·5 per cent. mortality of nymphs of the squash bug, *Anasa tristis* (Deg.), whereas parathion at the same rate gave only 59·4 per cent. and the other compounds (including toxaphene) gave negligible kill. Dusts containing 1 per cent. 3700, 3677, 3741 and parathion gave approximately 98·3, 95·2, 89 and 94 per cent. kill of *Aphis gossypii* Glov., and 3677 and parathion both gave more than 99 per cent. kill of *Septanychus* sp., both on cotton leaves, the other phosphorus compounds being less effective against them. When adults of *Anthonomus grandis* Boh. were caged on cotton plants dusted under a cylinder, none of the new materials was as effective as parathion, as measured by the median lethal dosage.

In a field test, in which 1 or 4 per cent. 3869 and 3901 and 20 per cent. toxaphene were applied in a schedule of seven applications at intervals of five days from 8th July, 3869 and 3901 were ineffective against *Anthonomus* and *Heliothis*, but toxaphene reduced infestation by both insects and increased the yield significantly.

GAINES (J. C.) & WIPPRECHT (R.). **Evaluation of Dusting and Spraying Schedules for Cotton Insect Control.**—*J. econ. Ent.* **43** no. 3 pp. 286–288, 1 graph, 5 refs. Menasha, Wis., 1950.

The authors summarise the results of two series of investigations carried out in Texas in 1946–49 on the control of cotton insects. The first, in 1947–49, was to evaluate different dust schedules and the effect on cotton yield of removing certain numbers of flowers, to simulate insect damage [*cf. R.A.E.*, A **30** 547]. Some of the plants received complete control (an average of ten

applications, beginning soon after the first hoeing and continued throughout the season), applications as needed (an average of seven) against the cotton fleahopper [*Psallus seriatus* (Reut.)], *Anthonomus grandis* Boh. and the bollworm [*Heliothis armigera* (Hb.)], or late control (six applications during July and August against *Anthonomus* and *Heliothis*), and others, from which flowers were removed, received continuous applications for complete control of all insects. All blooms were removed from these for 22, 25 or 27 days from the time they were first observed (37,220, 83,300 and 124,560 per acre, respectively, representing average estimated losses of 372, 833 and 1,246 lb. seed cotton per acre). The dusts used contained γ BHC (benzene hexachloride), DDT and sulphur in 1947 and toxaphene and sulphur in 1948 and 1949. The analysis of variance of each year's results indicated no significant difference between the yields for the different treatments. The combined analysis for the three years showed that the average yields in lb. per acre were 1,497, 1,403 and 1,578 for complete control, applications as needed and late control and 1,188, 1,260 and 1,139 for the three treatments involving the removal of flowers, as compared with 1,013 for no treatment, the minimum significant difference being 207 lb. Insects did not cause complete destruction of fruits early in the season, and the plants compensated for the loss later.

The other series was to determine the effect of differing dusting and spraying schedules on yield, and treatments involving complete control, applications as required and late control were applied as before, except that late control comprised five applications only. In 1946 and 1947, when dusts of calcium arsenate and (in 1947) the mixture of BHC, DDT and sulphur were applied, all treatments increased the yield, with little difference between them, and calcium arsenate gave higher yields than the mixture of BHC and DDT in all but the late control, where the rapid control of *Anthonomus* by the mixture allowed the cotton to fruit in a minimum of time. In 1948, when the weather was extremely dry, the yields were particularly low on plots receiving late treatment only, but in 1949, yields were again about the same for all schedules of applications, though plants receiving complete control set bolls approximately five days earlier than those receiving applications as needed. A spray of toxaphene was less effective than the toxaphene dust when used to control *Anthonomus* after migration.

Under the conditions of these experiments, it is apparently more economical to apply insecticides for the control of injurious populations of insects as needed than to make early applications followed by those necessary later to protect the crop from *Anthonomus* and *Heliothis*.

HANNA (R. L.) & GAINES (J. C.). **Tests of Insecticides for Control of Cotton Insects during 1949.**—*J. econ. Ent.* **43** no. 3 pp. 288–292, 4 refs. Menasha, Wis., 1950.

Since organic insecticides are compatible with a special (lime-free) calcium arsenate [*cf. R.A.E.*, A **38** 254], tests on the effectiveness of such mixtures in schedules of dusts for the control of the boll weevil, *Anthonomus grandis* Boh., and the bollworm, *Heliothis armigera* (Hb.), and the prevention of outbreaks of *Aphis gossypii* Glov. on cotton were carried out in Texas in 1949. The mixtures comprised the special calcium arsenate with 0·5 per cent. parathion, 0·5 per cent. γ BHC (benzene hexachloride) or 1 per cent. γ BHC, and are subsequently referred to as A, B and C, respectively, while a dust containing 20 per cent. toxaphene and 40 per cent. sulphur and one containing 3 per cent. γ BHC, 5 per cent. DDT and 40 per cent. sulphur are referred to as TS and BHC-DDT. In the first three experiments, which were replicated, all treatments gave significant control of the weevil and bollworm and significant yield increases. In the first of these, the dusts were applied at 13 lb. per acre

eight times between 6th July and 11th August, and A or B was more effective against *Anthonomus* than TS. There was no significant difference between them in bollworm control or yield, and all resulted in at least twice as much seed cotton as no treatment. In the second, seven applications at 14 lb. per acre were made between 24th June and 30th July, and A, C, TS and 20 per cent. toxaphene with 0·5 per cent. parathion were equally effective against the weevil and gave equal yields, though TS was slightly more effective than A or C against the bollworm. In the third, C, TS, BHC-DDT and 5 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were equally effective against the weevil and gave equal yields, but C was less effective than the other dusts against the bollworm. From these tests it is concluded that the calcium-arsenate mixtures were slightly more effective than the other insecticides against the weevil and slightly less effective against the bollworm.

In a non-replicated small-plot comparison, 2·5 per cent. aldrin [1,2,3,4,10,10-hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethanonaphthalene], applied seven times at 17 lb. per acre between 11th July and 11th August, was of little value against the bollworm and less effective against the weevil than A or TS applied eight times at 13 lb. per acre between 6th July and 11th August, and gave a smaller increase in yield. In another non-replicated experiment, in which four applications at 10–15 lb. per acre were made to five-acre plots between 7th and 23rd July, B, BHC-DDT and TS were all equally effective against *Anthonomus*, but B was slightly less effective than BHC-DDT and considerably less than TS against *Heliothis* and gave the lowest yield.

The addition of parathion or BHC to the special calcium arsenate was effective in preventing Aphid increases in all plots. No injurious infestations of red spider [*Septanychus* sp.] developed.

FENTON (F. A.). **Spraying and Dusting for Cotton Insect Control.**—*J. econ. Ent.* **43** no. 3 pp. 292–294. Menasha, Wis., 1950.

In Oklahoma in 1949, a spray prepared by diluting an emulsifiable concentrate containing 40 per cent. technical toxaphene and 20 per cent. technical DDT with water was compared with dusts of 3 per cent. γ BHC (benzene hexachloride) and 5 per cent. DDT with 40 per cent. sulphur, 20 per cent. toxaphene with 40 per cent. sulphur and calcium arsenate with either 1 per cent. γ BHC or 1 per cent. γ BHC and 5 per cent. DDT for the control of insects on cotton. The dusts were applied at 8–15 lb. per acre with a six-row power duster and the spray at 2·5–8·5 U.S. gals. per acre and pressures of 60–80 lb. per square inch, according to the height of the cotton ; the diameter of the spray droplets was 40–80 microns at the 60-lb. pressure. A sprayer with a boom attachment was used to spray six rows at a time with 1–3 nozzles per row ; these produced a very fine mist that appeared to envelop the plants. Spraying was done during the day under conditions of moderate air movement that would have been unfavourable for dusting ; on only one occasion was it too windy to spray. Infestation by the boll weevil [*Anthonomus grandis* Boh.] was very heavy, and the bollworm [*Heliothis armigera* (Hb.)] invaded the fields in late July, causing considerable injury in one.

In the first test, there was no significant difference in the increases in the yield or the grade of cotton in plots sprayed 3, 4 or 5 times in June–July to give about 1·8 lb. toxaphene per acre per application or those dusted 5–6 times with toxaphene or the BHC-DDT mixture with sulphur. Yields were not significantly lower on plots sprayed once during the pre-square stage than on those sprayed twice during the squaring period when both treatments were followed by two more sprays during flowering. The last spray applied, on

28th July, did not appreciably increase the yield, and dusts applied on that date were probably also ineffective, primarily because of drought. All treatments satisfactorily controlled the weevil.

In the second, in which both bollworms and weevils caused severe injury, the spray and the calcium-arsenate dusts all increased the yield, although heavy infestation by Aphids [*Aphis gossypii* Glov.] developed in plots receiving calcium arsenate, the addition of 1 per cent. γ BHC not proving sufficient to prevent this. The spray at 1·5 lb. toxaphene per acre neither increased nor controlled Aphid infestation. The addition of DDT to the dust of calcium arsenate with BHC was essential for control of the bollworm. The spray controlled both bollworm and weevil, and this and the dust containing DDT gave the greatest increase in yield, owing to good bollworm control.

In the third test, one application of the dust containing γ BHC, DDT and sulphur on 23rd June followed by five weekly applications of the spray from 5th July (averaging 1·5 lb. toxaphene per acre per application) gave excellent control of the weevil. When the spray was applied from an aeroplane on 15th and 22nd June at the rate of 1·75 lb. toxaphene and 5 U.S. gals. spray per acre it reduced weevil infestation on early cotton and appeared promising.

It is concluded that the spray was as effective against the bollworm and the weevil as the dusts usually recommended.

DOMINICK (C. B.). **Organic Insecticides for Control of Green June Beetle Larvae.**—*J. econ. Ent.* **43** no. 3 pp. 295–298, 1 ref. Menasha, Wis., 1950.

During the last few years, larvae of *Cotinis nitida* (L.) have been increasingly injurious to tobacco in plant beds in Virginia ; they become active in spring when the seedlings have 2–3 leaves, and uproot and kill the plants while burrowing in search of decaying vegetable matter. Poison baits have not given satisfactory control, and various organic insecticides were therefore tested in 1948 and 1949. Dusts were either mixed with a small amount of moist soil and applied after the seeds had germinated or in autumn when the beds had been prepared for chemical weed control, or mixed with fertiliser and applied the day before the tobacco was sown. In the last two cases, the mixtures were hoed into the top two inches of soil. Sprays were applied with hand equipment at the rate of 12·5 U.S. gals. per 100 sq. yards. Control percentages were computed by Abbott's formula [*cf. R.A.E.*, A **13** 331].

A 1 per cent. parathion dust, applied at 1–4 lb. per 100 sq. yards in autumn gave about 90–96 per cent. control when used alone, and also when applied with the regular weed-killer (Aero Cyanamid) in 1948, but not in 1949. Applications of 2 lb. 1·5 per cent. lindane [at least 99 per cent. γ benzene hexachloride], 2 lb. 5 per cent. toxaphene or chlordan, and 4 lb. 1 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] or heptachlor [1(or 3a),4,5,6,7,8,-8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] per 100 sq. yards were all less effective than parathion. When applied with the fertiliser in spring, 4 lb. 1 per cent. parathion, aldrin and dieldrin per 100 sq. yards gave 92·3, 70·8 and 67·8 per cent. control, respectively, and did not affect germination. Although aldrin and dieldrin gave less control than parathion, there was little surface activity in plots treated with them. Parathion was also effective when applied in surface sprays containing 1 lb. 25 per cent. wettable powder per 100 U.S. gals. water or in 1 per cent. dusts applied at 2–4 lb. per 100 sq. yards on 25th April, after surface activity had begun and the plants had 3–4 leaves. These gave at least 90 per cent. control, but sprays containing aldrin and dieldrin at 1 lb. 25 and 15 per cent. wettable powder per 100 U.S. gals., respectively, and

a 1 per cent. dieldrin dust at 4 lb. per 100 sq. yards were relatively ineffective. None of the treatments injured the plants.

GRIFFITHS (J. T.) & FISHER (F. E.). **Residues on *Citrus* Trees in Florida: Changes in Purple Scale and Rust Mite Populations following the Use of various Spray Materials.**—*J. econ. Ent.* **43** no. 3 pp. 298–305, 5 graphs, 8 refs. Menasha, Wis., 1950.

The authors review earlier reports on the effect of spray residues on populations of Coccids and mites on *Citrus* [*cf. R.A.E.*, A **38** 333, etc.] and show that copper and zinc have often been asssociated with scale increases and that such increases are directly correlated with the concentration of material used. In Florida, copper is applied to *Citrus* for the control of two diseases and as a nutritional element, usually 1–3 weeks after the fruit has set. Zinc is used as a nutritional element in January or February or in the post-bloom spray. Although these two materials are essential in the *Citrus*-spraying programme, it is hoped that spray recommendations may be altered to minimise deleterious effects when more is known of the action of the residues on *Citrus* foliage. The results reported in this paper show the effects of spray residues on *Lepidosaphes beckii* (Newm.), *Phyllocoptruta oleivorus* (Ashm.) and three fungi, *Myiophagus* sp., which is parasitic on *L. beckii* and an important factor in its control [*cf.* **38** 334], and *Hirsutella besseyi* and *H. thompsonii*, which are not known to be actively parasitic but are associated with mortality of the scales and the mite, respectively [*cf.* next abstract].

The following is based on the authors' summary. In 1949, orange trees receiving sprays containing zinc sulphate, lime or both (3 : 1), pyrophyllite, a basic copper sulphate or zinc carbonate, all used at 4 and 8 lb. spray material per 100 U.S. gals., were compared with unsprayed ones. All materials were applied once in spring (March or April) and again in early June. The sprays containing zinc carbonate, zinc sulphate with lime, and basic copper sulphate resulted in higher and more prolonged infestation by *L. beckii* than the other treatments, and unsprayed trees showed the smallest increase and the lowest scale population throughout the entire experimental period. Copper and zinc sprays resulted in fewer scales infected with *Myiophagus* or *H. besseyi* than other treatments. Lime caused rapid increases of scale. On 16th August, populations of *P. oleivorus* were found to have been affected by the various spray materials, unsprayed trees having least mites and those receiving zinc and copper the most. The mite populations were decreasing at the time, the dead mites consistently contained endoparasitic hyphal bodies and *H. thompsonii* was subsequently found on them. It is concluded that sprays containing zinc and copper favoured the Coccid and mite more than those containing lime or pyrophyllite and that lime was more favourable than pyrophyllite. All the sprays resulted in higher scale and mite populations, and no differences were found between the effects of 4 and 8 lb. material per 100 U.S. gals. spray.

FISHER (F. E.). **Entomogenous Fungi attacking Scale Insects and Rust Mites on *Citrus* in Florida.**—*J. econ. Ent.* **43** no. 3 pp. 305–309, 30 refs. Menasha, Wis., 1950.

For many years there has been a diversity of opinion as to the efficiency of the red-headed fungi that have been recorded as attacking various Coccids on *Citrus* in Florida [*cf. R.A.E.*, A **31** 89, etc.], and the author here reviews the literature on the subject and gives an account of investigations begun in 1946 to determine the true status of these fungi and to study the diseases of *Citrus*

pests, particularly Coccids. Observations on the life-cycle of *Myiophagus* sp. in *Lepidosaphes beckii* (Newm.) showed that this chytrid is a true parasite [*cf.* **38** 334] and directly dependent on the density and distribution of the scale population and also on moisture, without which germination of the zoosporangia and infection of the insects is impossible. It occurs frequently, but is of less importance, in *Chrysomphalus ficus* Ashm. (*aonidum* auct.) and several other Coccids. No evidence was obtained as to whether the red-headed fungi, *Sphaerostilbe aurantiicola*, *S. flammea* and *Nectria diploa*, which may possibly have been confused in the earlier literature, are parasitic on *L. beckii* and *C. ficus*. Two recently discovered fungi, *Hirsutella besseyi* and *H. thompsonii*, may be parasitic on nymphs of *L. beckii* and on *Phyllocoptruta oleivorus* (Ashm.), respectively, but this remains to be proved. If, however, they are not, they appear to be specific indicators of particular diseases of the Coccid and mite.

CHAPMAN (P. J.) & LIENK (S. E.). **Orchard Mite Control Experiments in western New York.**—*J. econ. Ent.* **43** no. 3 pp. 309–314, 1 graph, 3 refs. Menasha, Wis., 1950.

The following is largely based on the authors' summary. Although *Paratetranychus pilosus* (C. & F.), *Tetranychus bimaculatus* Harvey, *Bryobia praetiosa* Koch and a species of *Septanychus* occur in orchards in western New York, only the first two are of general economic importance. Counts on apple leaves showed that *P. pilosus* attains peak activity in midsummer, but that *T. bimaculatus*, which first breeds on the ground cover, is not abundant on the trees until later in the season [*cf. R.A.E.*, A **38** 497, 498].

In field tests, the winter eggs of *P. pilosus* were killed by a spray of 2 per cent. superior petroleum oil [*cf.* **38** 109] applied in the delayed dormant stage and by dormant sprays of 0·5 per cent. of preparations containing approximately 21·5 per cent. dinitro-o-sec.-butylphenol or dinitroamylphenol as the triethanolamine salt (DN-289 and Elgetol 50). Mite populations increased more rapidly in the dinitro than in the oil plots, though the initial kill of eggs appeared to be the same. However, it is possible that egg mortality throughout the tree was higher on the oil plot because of better spray coverage.

Seven organic phosphorus compounds, two dinitrophenols and three chlorinated products were tested against summer infestations on apple and cherry. They were used in single applications, with the exception stated. *T. bimaculatus*, *P. pilosus* and *B. praetiosa* showed essentially identical immediate response, but *T. bimaculatus* was the most difficult to control owing to reinfestation from the ground cover. Parathion did not give consistently high immediate kill at concentrations below 0·5 lb. 25 per cent. powder per 100 U.S. gals., and twice this quantity was needed to give lasting control of *Paratetranychus*. A preparation containing 31·5 per cent. ethyl paranitrophenyl thionobenzenephosphonate (EPN) gave similar results. S-mercaptoacetylurea O,O-dimethyl dithiophosphate gave good and lasting protection against *T. bimaculatus*, and parachlorophenyl parachlorobenzene sulphonate also showed prolonged action. DN-111 (20 per cent. dicyclohexylamine salt of dinitro-o-cyclohexylphenol) was found to be largely inactivated as an acaricide in the presence of hydrated lime, and Arathane (25 per cent. dinitrocaprylphenylcrotonate), β-chloroethyl-β-(tert. butylphenoxy)-α-methylethylsulphite and S-carbamylmethyl O,O-dimethyl dithiophosphate were also less effective. Tetraethyl pyrophosphate gave poor results against *T. bimaculatus* when applied once, but good prolonged control when applied twice. A material containing 2,4-dichlorophenyl benzenesulphonate gave good results against *P. pilosus*.

Snapp (O. I.). **DDT and some of the newer Insecticides for Control of Peach Tree Borers.**—*J. econ. Ent.* **43** no. 3 pp. 315–318, 1 ref. Menasha, Wis., 1950.

The following is largely based on the author's summary. In experiments carried out in Georgia in 1945–49 on the control of *Aegeria* (*Sanninoidea*) *exitiosa* Say on peach, poor results were given by DDT dusts and sprays directed at the fruit and foliage for the control of the plum curculio [*Conotrachelus nenuphar* (Hbst.)], by single applications of dusts of DDT or BHC (benzene hexachloride) or sprays of BHC, chlordan, toxaphene, DDT, hexaethyl tetraphosphate, parathion or *Ryania* to the trunk and lower parts of the large boughs, by BHC dust applied in a continuous band round the tree and covered with soil, and by DDT and BHC suspensions poured round the base of the tree and covered with soil.

Sprays containing 4 lb. actual BHC (12 per cent. γ isomer) or DDT (both in 50 per cent. wettable powders) per 100 U.S. gals. applied to the trunk and lower part of large branches two or three times at intervals of about a month during the oviposition period gave good results and were as effective as fumigation with propylene-dichloride or ethylene-dichloride emulsion or paradichlorobenzene crystals applied to the soil round the base of the trunks in orchards in which untreated trees averaged less than two borers per tree. They also gave fair to good control in orchards with heavier infestations, although the fumigants appeared to be more dependable. Against the lighter infestations, BHC and DDT were about equally effective in schedules involving two or three spray applications, but against heavier ones, BHC was more effective than DDT and almost if not quite as effective as fumigation when applied three times. Hexachloroethane crystals, applied in the same way as paradichlorobenzene, were inferior to the BHC and DDT sprays and to the other fumigants, which were about equal to one another, though propylene-dichloride emulsion appeared to kill a little faster than ethylene-dichloride emulsion or paradichlorobenzene. None of the materials injured the trees or the crop.

Roan (C. C.), Fernando (H. E.) & Kearns (C. W.). **A radiobiological Study of four organic Phosphates.**—*J. econ. Ent.* **43** no. 3 pp. 319–325, 1 graph, 3 refs. Menasha, Wis., 1950.

The following is based on the authors' summary and conclusions. TEPP (tetraethyl pyrophosphate), tetraisopropyl pyrophosphate, tetra-n-butyl pyrophosphate and O,O-diethyl O-paranitrophenyl phosphate were synthesised from radioactive phosphorus and used in studies employing the techniques of radiobiological assays. In a test designed to determine the effect of four solvents, dioxane, benzene, propylene glycol and ethyl alcohol, on the rates of penetration of the phosphates into the body of *Periplaneta americana* (L.) following topical applications on the ventral cervical membrane, penetration of TEPP after 60 minutes was greatest in dioxane and progressively less in propylene glycol, ethyl alcohol and benzene ; that of tetraisopropyl pyrophosphate was greatest in ethyl alcohol and progressively less in propylene glycol, dioxane and benzene ; and those of the other two phosphates were greatest in propylene glycol and progressively less in ethyl alcohol, dioxane and benzene. Following topical applications of propylene-glycol solutions, the distribution throughout the body was most rapid for TEPP and progressively less so for tetraisopropyl pyrophosphate, tetra-n-butyl pyrophosphate and O,O-diethyl O-paranitrophenyl phosphate ; this closely parallels the order of solubility in water of these materials. TEPP was excreted from the body the most rapidly and tetra-n-butyl pyrophosphate, tetraisopropyl pyrophosphate and O,O-diethyl O-paranitrophenyl phosphate progressively less so.

Experiments to determine the tissue concentration of radioactive TEPP or its metabolite after topical application showed that the highest concentrations occurred in the fore gut, with the concentration in the body fluid rising rapidly at first and then falling sharply ; slight increases were noted in muscle tissue during the first hour after treatment. After both sublethal and lethal administrations, the fore gut showed a marked selective absorption of TEPP or its metabolites and a rapid secretion of it into the gut lumen. Comparison of concentrations of TEPP in the tissues of surviving and prostrate cockroaches showed considerably higher concentrations of radioactive material in the fore gut of surviving than of prostrate cockroaches and higher concentrations in the muscles of prostrate than of surviving ones.

Although no radioactive materials were detected in the central nervous system, the authors do not consider that this necessarily indicates a complete absence of such materials from this region, since the specific activity of the tracer compound employed had deteriorated to a rather low level when the experiment was performed.

BURGESS (E. D.). **Development of Gypsy Moth Sex-attractant Traps.**—*J. econ. Ent.* **43** no. 3 pp. 325–328, 4 figs., 3 refs. Menasha, Wis., 1950.

The author summarises the development of the use of traps baited with living females of *Lymantria* (*Porthetria*) *dispar* (L.) or extracts of their last two abdominal segments, which are attractive to the males of that species, for revealing fresh infestations by it in the United States [*cf. R.A.E.*, A **33** 238] and describes an improved type of trap known as the Graham trap that was designed in 1947 for use with the extract. It consists of a metal cylinder 7 ins. long and 4 ins. in diameter with cones of screen pointing inwards in the ends. A hole at the apex of each cone permits the entry of moths, and the cylinder is lined with paper coated with an adhesive to catch them. A small cylinder of corrugated paper was found a better bait dispenser than a wad of cotton, which did not permit complete evaporation. It is suspended in the trap by a wire, the two ends of which protrude to the outside and are used to attach the trap in a horizontal position to the tree. Red or white traps seemed inferior to others, but otherwise colour seemed to be of little importance. It was found that the longer the unfertilised females were kept before clipping, the more effective was the extract, but mortality increased greatly after 24 hours ; tips clipped from dead moths were ineffective. Hydrogenation [*cf.* **33** 239] seemed to make little difference. Tip material collected in French Morocco in 1948 was found to be attractive to male moths in the United States.

WEAVER (N.). **Toxicity of organic Insecticides to Honeybees : Stomach Poison and Field Tests.**—*J. econ. Ent.* **43** no. 3 pp. 333–337, 2 graphs, 5 refs. Menasha, Wis., 1950.

The following is based on the author's summary. When honey bees were starved for a night, given food containing emulsified solutions of insecticide, kept at a constant temperature and humidity and observed for three days, the median lethal dosages of γ BHC (benzene hexachloride), chlordan and toxaphene at 94°F. were 0·001296, 0·01249 and 0·27778 mg. per gm. body weight. Concentrations of DDT sufficient to cause mortality at that temperature could not be obtained, but at less than 82°F., the median lethal dosage was 0·2913 mg. DDT per gm.

When bees were allowed to work on rows of flowering cotton inside large cages, mortality was high when the bees were left in them for more than three weeks, whether the cotton was treated or not. In all but one cage, the cotton was dusted weekly with varying dosages of an insecticide for eight weeks and

dead bees were collected six days a week. The safest of the dusts tested was one containing 20 per cent. toxaphene and 40 per cent. sulphur, which resulted in negligible death on all days, with little variation between applications. Dusts containing 10 per cent. DDT or chlordan with 40 per cent. sulphur were more toxic, but did not cause high mortality. Bees were repelled from the cotton for about three hours after the application of a mixture containing 3 per cent. γ BHC, 5 per cent. DDT and 40 per cent. sulphur, and mortality from this material was slight, though reports from beekeepers in Texas indicate that insecticides containing BHC may be very toxic under certain conditions. Preliminary tests indicate that parathion may be more toxic to bees than any of these materials. None of the organic insecticides tested was as destructive as calcium arsenate to bees when used in the field.

STARNES (O.). **Absorption and Translocation of Insecticides through the Root Systems of Plants.**—*J. econ. Ent.* **43** no. 3 pp. 338–342, 5 refs. Menasha, Wis., 1950.

The results are given of investigations in New Jersey in which plants were grown in soil containing various concentrations of insecticides to observe the effect of each insecticide on plant growth and yield and on insects on the plants. Bioassay and chemical tests to ascertain the amounts of insecticide in the plants were also made.

In field tests, BHC (benzene hexachloride), technical chlordan, 25 per cent. parathion wettable powder and 25 per cent. toxaphene were diluted and applied to a sassafras sandy loam with a grain drill, after which the soil was disked and planted with potatoes, beans, beet, maize or tomatos. Observations throughout the growing season revealed no significant differences in plant growth due to treatment with 0·125–1 lb. γ BHC, 2–16 lb. chlordan, 5–20 lb. actual parathion or 25 or 50 lb. toxaphene per acre. Yield data were taken only on potato, and the only significant reduction was on plots receiving 50 lb. toxaphene per acre. Counts of the more important insects on the plants were made at weekly intervals, but there were no significant differences that could be correlated with treatments. Bioassay tests, in which the mortality of larvae of *Aëdes aegypti* (L.) in distilled water containing macerated tissue from treated plants was compared with that in water containing known quantities of insecticide and macerated untreated plant tissue [*cf. R.A.E.*, A **39** 6], did not show the presence of toxicant in the aerial parts of the plants at various stages or in beans at the canning stage, beet roots, mature sweet maize, potato tubers or ripe tomatos. This method of making the assay was compared with the one using benzene extracts of the tissue [*loc. cit.*] and both were found to be sufficiently sensitive to yield quantitative indication of the presence of a toxicant.

In greenhouse tests, in which beans, beet, maize, potatoes and tomatos were grown in soil containing the equivalent of 5 lb. γ BHC, chlordan, parathion or toxaphene per acre, no significant effect was observed on germination, and larvae and adults of *Epilachna varivestis* Muls. on the beans, larvae of *Pyrausta nubilalis* (Hb.) on beet and maize and *Macrosiphum* (*Illinoia*) *solanifolii* (Ashm.) on potato and tomato developed normally and did not suffer significantly different mortality from those on untreated plants. Bioassay of the tissue of the entire plants above ground and of beet roots, potato tubers and tomato fruits did not indicate the presence of toxicant. When potatoes were planted in soil containing 10–40 lb. γ BHC or 25–100 lb. parathion per acre, there was significant retardation in the sprouting of the tubers, directly proportional to the amount of insecticide present, and a reduction in growth that persisted until maturity. *M. rosae* (L.) caged on various parts of the plants at intervals throughout their growth developed normally in all cases. When, however, several replicates were infested with an uncontrolled population of Aphids

and observed at intervals, there were significant reductions in the population on plants growing in treated soil and these could be correlated with the amounts of insecticide applied. Three of the replicates were then infested with uncontrolled larvae of *Pyrausta nubilalis* (Hb.), and there was a reduction in the survival of the larvae on plants treated with either insecticide, though it was not in accordance with the concentration applied in the case of BHC. When the harvested tubers were infested with newly hatched larvae of *Gnorimoschema operculella* (Zell.), only 8 per cent. of the larvae in tubers grown in soil containing 10 lb. γ BHC per acre pupated and all those in tubers grown in soil containing 20 and 40 lb. per acre died within a few days. Larvae developed in tubers grown in all concentrations of parathion, and rather more pupated in tubers grown in soil containing 100 lb. per acre than in those grown in untreated soil. Preliminary bioassay tests of the entire aerial portions of the plants showed high toxicity to *Aëdes* larvae for all treatments and further tests indicated that the plants above ground, the tubers and the soil at harvest contained appreciable amounts of toxicants ; these results were confirmed by chemical analysis for parathion.

BACON (O. G.). **Control of Corn Earworm on Sweet Corn in northern California.**—*J. econ. Ent.* **43** no. 3 pp. 364–371, 2 refs. Menasha, Wis., 1950.

The results are given of experiments carried out to find a more rapid method than oiling individual ears for controlling *Heliothis armigera* (Hb.) on sweet maize, in which sprays of DDT, lindane [at least 99 per cent. γ benzene hexachloride], Pyrenone (0·53 per cent. pyrethrins, 10·7 per cent. technical piperonyl butoxide, 78·27 per cent. petroleum oil and 10·5 per cent. polyethylene glycol), dieldrin [1,2,3,4,10,10-hexachloro-6, 7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and methoxy-DDT (methoxychlor), dusts of lindane, and dusts and aerosols of DDT, dieldrin and aldrin were applied several times in July–September. The following is based on the author's summary. DDT was the most effective of the materials tested, and the only one that gave promising results ; 2–3 applications of emulsion sprays containing 6 lb. actual DDT and 5–10 per cent. mineral oil or suitable wetting agents per 100 U.S. gals. adequately wetted the silk mass and penetrated the silk channel to form a barrier against the larvae and gave satisfactory control when properly timed and applied. DDT dusts gave 60–70 per cent. control of small populations of larvae, but were ineffective against large populations and never so satisfactory as the sprays or individual ear injections of DDT in oil. Dusting resulted in a light deposit of insecticide on the outside of the silk mass only, so that larvae that penetrated this thin barrier were free to infest the ears. Aerosols were less effective than either sprays or dusts, presumably because insufficient insecticide was deposited in the silk mass.

Where DDT had been used, residues were rather large on the husks and silks of the harvested ears, but little or no DDT was found on the edible portions. The greatest amount of residue noted was 2·1 parts per million on ears treated with 1 per cent. DDT in oil by the injection method, and it was considered that this could be eliminated by trimming.

WATTS (C. N.) & BERLIN (F. D.). **Piperonyl Butoxide and Pyrethrins to control Rice Weevils.**—*J. econ. Ent.* **43** no. 3 pp. 371–373, 5 refs. Menasha, Wis., 1950.

Pyrethrum powder, alone or diluted with diatomaceous earth, has given prolonged protection of bagged wheat and maize from *Calandra* (*Sitophilus*) *oryzae* (L.), but is too scarce for general use, and experiments were therefore

carried out to determine the degree of synergism obtained by the addition of piperonyl butoxide to reduced amounts of pyrethrins. Comparative tests of pyrethrins and piperonyl butoxide in separate dusts and mixed together in the ratios of 1 : 5, 1 : 10, 1 : 13·3 and 1 : 20 were therefore made in the laboratory on whole-grain soft winter wheat with a moisture content of about 12 per cent. and a dry-ash content of about 2 per cent. ; the temperature was maintained at 78–82°F. and the relative humidity at 48–50 per cent. The dusts were used at a rate equivalent to about 1 lb. per 10 bushels grain and thoroughly distributed in the grain by agitation for one hour, after which the weevils were introduced and left undisturbed except for examination seven and 30 days later. The results are shown in a table. The percentages of weevils dead after seven and (in brackets) 30 days were, respectively, 10 (17) for no treatment, about the same for dusts of 0·8 and 1·2 per cent. piperonyl butoxide alone, 49 (79) and 78 (94) for 0·2 and 0·4 per cent. pyrethrins alone, 86 (93) and 91 (99) for 0·04 per cent. pyrethrins with 0·4 and 0·8 per cent. piperonyl butoxide, and 100 (100)and 99 (100) for 0·08 per cent. pyrethrins with 0·4 and 0·8 per cent. piperonyl butoxide.

An empirical figure obtained by multiplying the concentration of pyrethrins by ten and adding the result to the concentration of piperonyl butoxide, termed " total concentration ", was found to be approximately proportional to the effectiveness of the combination.

Lieberman (F. V.), Snow (S. J.) & Sorenson (C. J.). **Control of Alfalfa Weevil in Hay Alfalfa with DDT Dust.**—*J. econ. Ent.* **43** no. 3 pp. 374–376, 2 figs., 2 refs. Menasha, Wis., 1950.

The use of DDT for the control of insects attacking lucerne in the western United States is approved for seed crops, but not for hay crops, in view of the possible danger to the health of animals and man. In connection with extensive investigations of the toxicity of food treated with DDT to farm animals, experiments were carried out in Utah in 1947 and 1948 on the effect of various dosages of DDT in controlling *Hypera variabilis* (Hbst.) (*postica* (Gyll.)), the principal insect pest of hay lucerne there.

The following is largely the authors' summary of the results. When DDT dusts were applied with power equipment in a heavily infested field, 1–4 lb. actual DDT per acre gave adequate to excellent control, but 0·5 lb. did not prevent economic damage. Treated plots yielded 25–44 per cent. more hay than untreated ones, and the average DDT residue on the cured hay ranged from 9 parts per million on first-crop hay treated with 0·5 lb. DDT per acre in 1948 to 42 p.p.m. on first-crop hay treated with 4 lb. DDT per acre in 1947.

Wolfenbarger (D. O.). **Red Mite Control on Avocados and Mangos.**—*J. econ. Ent.* **43** no. 3 pp. 377–380. Menasha, Wis., 1950.

The following is based on the author's summary of tests in 1948 and 1949 on the control of *Paratetranychus yothersi* (McG.), which is one of the principal pests of avocado and mango in Florida, though it varies in injuriousness with years, groves and varieties. Sulphur, applied as a dust or spray, proved very effective on both avocado and mango, as also did oil emulsions on avocado. Sprays an ddusts of parathion, dinitro-o-cyclohexylphenol, azobenzene, and di(parachlorophenoxy)methane, and sprays of tetraethyl pyrophosphate, potassium ammonium selenosulphide (Selocide) and dinitrocaprylphenyl-crotonate proved relatively ineffective.

Shaw (J. G.). *Eretmocerus serius* **as a Parasite of the Citrus Blackfly in Mexico.** —*J. econ. Ent.* **43** no. 3 pp. 380–382, 1 fig., 4 refs. Menasha, Wis., 1950.

Since 1943, *Eretmocerus serius* Silv. has been introduced into most parts of Mexico in which *Aleurocanthus woglumi* Ashby attacks *Citrus*, but has not as a rule effected commercial control [*cf. R.A.E.*, A **35** 77 ; **37** 107, etc.]. Examination of pupae of the Aleurodid on samples of 25 leaves collected in Morelos between October 1945 and April 1949 showed that the percentage parasitism fluctuated from 8–10 at the beginning of the rainy season in May to 85 at its end in October. It followed a uniform trend each year, increasing rapidly during the rainy season and decreasing rapidly during the long dry season, while the Aleurodid population remained high and prevented fruit production. Observations in the States of Colima, Jalisco, Sinaloa and San Luis Potosi confirmed the finding in Morelos that the long periods of drought usually prevent normal increase and development of the parasite. The only plantings in which it was effecting commercial control were at Tecoman, Colima, where the coastal area is several miles wide, very flat, and very humid except in March and April.

Michelbacher (A. E.), Middlekauff (W. W.) & Davis (D.). **Environmental Resistance as a Factor in Codling Moth Control on Walnuts.**—*J. econ. Ent.* **43** no. 3 p. 383. Menasha, Wis., 1950.

Natural environmental factors are important in regulating the population of the codling moth [*Cydia pomonella* (L.)] on walnut in California, though their effect is masked by the artificial control measures necessary. During investigations at Linden, in which the control programme was gradually improved, the percentage of infested nuts in the harvested crops from the untreated trees fell from over 25 in 1942 to 6·8 in 1945 and 7 in 1946, but rose to 44 in 1948 and was 22 in 1949. It is considered unlikely that the lower infestation in 1945 and 1946 was a result of more efficient spraying in view of the rise in 1948 and 1949 ; this rise was obviously not due to increased resistance of the moth to lead arsenate, as excellent control was obtained where sprays were properly timed and carefully applied and there was a general increase in areas in which no sprays were applied.

It appears that when climatic and biotic factors afford a high environmental resistance, the codling-moth population is reduced and spray control programmes benefit, whereas when they favour the moth, spray programmes are severely tested and satisfactory control can be obtained only if the sprays are properly timed and thoroughly applied. The action of natural control factors becomes more apparent when populations increase ; in particular, predators and parasites often occur in large numbers when the host is very abundant. In 1949, there was a very large second brood of *C. pomonella* and the average number of eggs per nut was over 1·75 in the experimental orchard. Approximately 50 per cent. of the eggs were parasitised by a species of *Trichogramma* identified by S. E. Flanders as *T. embryophagum* (Htg.) [probably the species commonly called *T. pretiosum* Ril. (*cf. R.A.E.*, A **25** 719, etc.)], with usually three parasites in each egg. Although parasitism did not give successful control, the large moth population created conditions favourable for a rapid rise in parasite population.

Because of the powerful natural environmental factors that tend to regulate populations of *C. pomonella*, every effort should be made to avoid practices that might alter them in favour of the moth. Control measures should be used with discrimination and applied only when needed, and the insecticide should be used at a rate no higher than necessary to ensure satisfactory control.

Dills (L. E.) & Odland (M. L.). **Insecticide Tests with Cabbage Caterpillars.** —*J. econ. Ent.* **43** no. 3 pp. 384–385, 6 refs. Menasha, Wis., 1950.

In further field tests in 1948 and 1949 of organic insecticides for the control of caterpillars attacking cabbage in Pennsylvania [*cf. R.A.E.*, A **38** 65–66], dusts were applied three times at intervals of 2–3 weeks with a mixture of pyrophyllite and aluminium magnesium silicate (3 : 1) as the carrier. The larvae of *Pieris rapae* (L.), *Trichoplusia ni* (Hb.) and *Plutella maculipennis* (Curt.) were present in the plots at all times, but their relative abundance varied considerably because of parasitism and disease. In untreated plots, the three species represented 84·3, 12·4 and 3·3 per cent., respectively, of the population on 16th September 1948, 14·8, 62·6 and 22·6 per cent. on 11th August 1949 and 54·7, 44·7 and 0·6 per cent. on 14th September 1949. Dusts containing 1–3 per cent. DDT or DDD (dichlorodiphenyldichloroethane) gave very good control in both years, and 1 and 2 per cent. dieldrin [1,2,3,4,10,10-hexachloro - 6,7-epoxy - 1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendomethanonaphthalene], which were used in 1949 showed promise of being even better. Aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] at 1·5–3 per cent. and toxaphene at 1–3 per cent. gave considerable control but were inferior to dieldrin, DDT and DDD ; 3 per cent. chlordan was less effective, and the results for single years indicated that 2–3 per cent. methyl-DDT (ditolyl trichloroethane) and 5 per cent. 7-chloro-5-methyl-1,4,2-benzothiazine-3(4)-one were quite ineffective.

Wolcott (G. N.). **The Sugar-cane Rhinoceros Beetle.**—*J. econ. Ent.* **43** no. 3 p. 385, 3 refs. Menasha, Wis., 1950.

Larvae of *Strategus barbigerus* Chapin (*titanus* auct.) used at one time to be often injurious to young sugar-cane in Porto Rico [*cf. R.A.E.*, A **9** 573], but the introduced toad, *Bufo marinus*, proved to be able to feed on the adults, and the beetle and also its specific parasite, *Campsomeris atrata* (F.), apparently disappeared from the island for several years during the time when the toad was most abundant. The beetle reappeared, however, when the toad became scarce [*cf.* also **38** 396] and has since increased in numbers. Both it and its parasite have been consistently present on the neighbouring island of Mona, where *B. marinus* does not occur.

Lea (A. O.) & Niswander (R. E.). *Oncopeltus fasciatus* **reared for Laboratory Testing on Watermelon Seeds.**—*J. econ. Ent.* **43** no. 3 p. 386. Menasha, Wis., 1950.

Oncopeltus fasciatus (Dall.) has been reared for several years in the laboratory in Ohio on seeds of milkweed [*Asclepias*], but as these are not always available in quantity investigations to find an alternative food were made. The bugs fed on watermelon seeds if the seed coat was removed or cracked, and nymphs completed all instars and matured into fertile adults when fed on the exposed embryo. The seeds were run through a hammer mill with no screen so that they were just cracked open, as the insects apparently cannot feed on finely ground material, but must probe the seeds. The embryo and seed coats needed no separation before being used. There was no difference in the rate of development, size or vigour of individuals reared on milkweed and watermelon seeds.

Wene (G. P.) & Riherd (P. T.). **Oil Emulsion to control Rhodes Grass Scale.**—*J. econ. Ent.* **43** no. 3 p. 386. Menasha, Wis., 1950.

Antonina graminis (Mask.) is destructive to grass on pastures, lawns and golf greens in the Lower Rio Grande Valley of Texas [*cf. R.A.E.*, A **38** 493].

Numerous nymphs were observed on lawns during the heat of the day in late March 1947, and an emulsion spray containing 1·6 per cent. oil was applied to small plots at an estimated rate of 105 U.S. gals. per acre. One day after application, there were averages of 14·2 dead and 0·4 living nymphs per 9 sq. ins. on treated areas and 9·8 living nymphs on untreated ones, and four days later there were 2·5 living nymphs per 9 sq. ins. on treated plots and 14·2 on the untreated ones. The numbers of nymphs found at the second count showed that the oil emulsion had little or no effect on the adult scale and had lost its effectiveness against the nymphs.

Shaw (F. R.), Bailey (J. S.) & Wheeler (E. H.). **The Blueberry Flea Beetle.**—*J. econ. Ent.* **43** no. 3 p. 387, 2 refs. Menasha, Wis., 1950.

In 1947, *Haltica* (*Altica*) *sylvia* Mall. [which is the blueberry flea-beetle previously recorded in Maine (*R.A.E.*, A **7** 58 ; **26** 333) and Canada (**32** 283) as *H. torquata* Lec.] was found attacking low bush blueberries at Granville and Blandford in Massachusetts. It is reported from Maine, where this flea-beetle has been injurious in the blueberry barrens for many years, that it overwinters in the egg stage, and that the larvae hatch in early spring, feed on buds and leaves of the low bush varieties for 2–3 weeks and pupate by the end of June. The pupal stage lasts 10–18 days and the adults appear at about the beginning of July, feed on the foliage and deposit their eggs singly on or near the ground at about the end of July. Control measures in Maine consist of burning over infested areas in spring to destroy the eggs, and Lathrop stated in a personal communication that there is a growing tendency to apply DDT against newly hatched larvae on valuable sections, but that this should not be done after the blossoming period as the insecticide may kill bees and leave residues at picking time ; also, two applications in July 1947 reduced the size of the berries and decreased the yield. He stated that a dust of calcium arsenate, copper sulphate and hydrated lime (50 : 10 : 40) applied at 6 lb. per acre against the blueberry fruit-fly [a race of *Rhagoletis pomonella* (Walsh)] kills many of the adult flea-beetles.

In 1948, *H. sylvia* had defoliated about 18 acres of bushes in Massachusetts by 10th June, when larvae were abundant and one adult was found. On 28th June, adults were very numerous and pupae and one immature adult were found in chambers in the soil within half an inch of the surface. Adults caged on blueberry plants at that time were not observed to pair or oviposit. In preliminary tests made on 9th July, 1 per cent. parathion dust and a spray of 5 cc. 35 per cent. commercial tetraethyl-pyrophosphate concentrate per 3 U.S. gals. water gave immediate control and 5 per cent. DDT dust gave good though less rapid control. Observations of beetles from treated plots showed that all three materials were highly toxic to them. DDT would probably be preferable to the others from the standpoint of cost and prolonged toxicity.

Careful examination of the plants and of débris round them in late October revealed the presence of no unhatched eggs, many hatched eggs in the débris and one adult. The finding of this adult and the one observed in early June suggested the possibility that the adults may overwinter in Massachusetts.

Carlson (E. C.), Lange jr. (W. H.) & Sciaroni (R. H.). **Brussels Sprouts Seed Loss in California caused by the Cabbage Seed Pod Weevil.**—*J. econ. Ent.* **43** no. 3 pp. 389–390, 2 refs. Menasha, Wis., 1950.

Ceuthorrhynchus assimilis (Payk.), which causes considerable loss of crucifer seed crops in Washington, Oregon and Idaho [*cf. R.A.E.*, A **35** 299–300, etc.], was first reported from California in 1946 [**35** 410] and occurred on cauliflower seed crops in Santa Clara County in 1948, but caused no extensive economic

damage in the State until 1949, when it drastically reduced seed production of brussels sprouts in San Mateo County. The infestation was found to be extensive in May, when most of the plantings already had a high proportion of pods set. Some growers applied dusts containing 1 per cent. γ BHC (benzene hexachloride) 2–4 times, but good control was not expected, as it usually requires 4–5 applications at intervals of 10–12 days beginning immediately after the beginning of seed-pod development, and the results showed that the weevil caused extensive seed loss and that control was not obtained in fields in which pod set was well advanced before dust applications were begun. However, three applications reduced seed loss from 30 to 14 per cent. in one field, and four reduced it to 7·4 per cent. in another.

No evidence of parasitism was observed ; *Trichomalus fasciatus* Thoms. and *Necremnus duplicatus* Gah., the major parasites of the weevil in the Pacific Northwest [*cf.* **34** 76], have apparently not become established with it in San Mateo County. The damage caused there and the rapid spread of the weevil in the State indicate that it may become an important pest in the larger areas in California in which crucifer seed is produced.

Reddy (D. B.). **Influence of sound Kernels compared with halved Kernels of Wheat upon Oviposition of the Rice Weevil.**—*J. econ. Ent.* **43** no. 3 pp. 390–391, 1 ref. Menasha, Wis., 1950.

Wheat grains of uniform size and variety in equilibrium with 77 per cent. relative humidity, either whole or cut across to separate the two ends, were put horizontally in rearing jars with the sutures of the kernels downwards, and females of *Calandra* (*Sitophilus*) *oryzae* (L.), not more than two months old were introduced into jars containing whole kernels, half kernels or mixtures of equal numbers, weights or surface areas of whole and half kernels. Dissection of the wheat after 48 hours showed that whenever a mixture was used, the females laid more eggs in whole than in half kernels ; when whole and half kernels were offered separately in equal numbers, about the same number of eggs was laid in each culture, but when there were twice as many half as whole kernels, more were laid in the halves. In the mixtures, ten females laid averages of 32·3 and 10·6 eggs in sound and half kernels when the numbers of whole and half kernels were equal, 21·3 and 7·6 when the surface areas were equal and 21 and 10·6 when the weights were equal. About equal numbers of eggs were laid at the two ends of the kernels, although the females showed a slight preference for the stigmatic end, whether whole kernels, half kernels or mixtures were offered. Very few eggs were laid in the cut ends of the half kernels or the middle portion of whole ones.

Polivka (J. B.). **A new Insecticide to control Turf Insects.**—*J. econ. Ent.* **43** no. 3 pp. 391–392. Menasha, Wis., 1950.

In Ohio in June 1949, technical heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] was applied to 100-sq. ft. plots of turf infested with the larvae of various Lamellicorns, chiefly the Japanese beetle [*Popillia japonica* Newm.], at rates of 1, 5, 10 or 20 lb. per acre. To simplify distribution, the amount of heptachlor necessary for each plot was thoroughly mixed with 2 lb. milorganite and broadcast with a fertiliser spreader. Examination of soil samples on 19th September, when the grass in untreated plots was brown and the turf was full of holes made by birds feeding on the larvae, showed that all dosages had given excellent control.

Early in September, larvae of *Cyclocephala borealis* Arr. were abundant in turf in several areas in Ohio, and on 12th September, plots of 1,120 sq. ft. were treated with 5 lb. parathion or BHC (benzene hexachloride), 10 lb. heptachlor,

aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] or chlordan, 25 lb. DDT, DDD (dichlorodiphenyldichloroethane) or toxaphene or 500 lb. lead arsenate per acre. Examination of soil samples from treated and untreated plots on 10th October indicated that the percentage reductions in the numbers of larvae were 75 for heptachlor, 65 for aldrin, 52·5 for parathion and BHC, 31–34 for DDT, chlordan and lead arsenate, 15 for toxaphene and 0 for DDD, a reduction of 50 per cent. being required for significance.

GIBSON (K. E.) & LANDIS (B. J.). **Control of the Iris Whitefly on Potatoes.**—*J. econ. Ent.* **43** no. 3 pp. 394–396, 2 refs. Menasha, Wis., 1950.

In 1948, the feeding of *Aleurodes spiraeoides* Quaint. caused a loss of plant vigour in some potato fields in the Yakima Valley, Washington [*cf. R.A.E.*, A **37** 202], and preliminary information on the control of this whitefly on potato was obtained by recording the numbers surviving after multiple applications of dusts for the control of Aphids at Toppenish in June and July and after single applications of dusts and sprays at Zillah in August. When five applications were made between 6th June and 28th July, 10 per cent. DDT reduced the numbers of adults and eggs (but not larvae and pupae) more than 5 per cent. DDT alone, with 1 per cent. nicotine or with 1 per cent. TEPP (tetraethyl pyrophosphate). The TEPP dust was the least effective, probably because the mixture was wet and the dosage applied was comparatively light. When an entire field was dusted with a mixture containing 5 per cent. DDT and 0·5 per cent. TEPP six times between 12th June and 14th August, the numbers of eggs and adults were smaller than they were on the plots dusted five times with 10 per cent. DDT, and promising results against the adults in another field were given by seven weekly applications of 1 per cent. parathion, beginning on 17th May.

Single applications of dusts containing 5 per cent. DDT alone and with 1 per cent. TEPP, 4 per cent. DDT fused with sulphur, 1 per cent. parathion or 1 per cent. BHC (benzene hexachloride) or of sprays containing 2 lb. technical DDT as an emulsified solution or suspension or 1 lb. technical chlordan in emulsified solution per 100 U.S. gals. had little effect on the larvae within the first two weeks, but the DDT and parathion dusts reduced the egg populations by 87–93 per cent. as a result of adult mortality. The BHC dust and chlordan spray were not effective, and DDT sprays were less effective than DDT dusts.

ANDERSON (L. D.) & REYNOLDS (H. T.). **Potato Tuberworm Control in southern California.**—*J. econ. Ent.* **43** no. 3 pp. 396–397, 2 refs. Menasha, Wis., 1950.

A potato field in California became heavily infested by *Gnorimoschema operculella* (Zell.) in 1948 as a result of the dumping of potato tubers nearby for conversion into hog food. Since the larvae were mining into the foliage and stems and threatening to kill the plants in a short time, insecticidal dusts were applied at about 40 lb. per acre on 14th and 20th September. By 22nd September, 1·5 per cent. lindane [at least 99 per cent. γ benzene hexachloride], 10 per cent. toxaphene, 5 per cent. DDD (dichlorodiphenyldichloroethane) and 5 per cent. DDT had given 100, 98·5, 97·8 and 97·1 per cent. control, whereas 5 per cent. chlordan had given only 69 per cent. ; this was significantly inferior to the other treatments, but significantly better than none. Lindane killed very rapidly, but the other insecticides were slower in action. When the potatoes were dug, on 8th December, no injury could be found on the tubers. Raw potatoes showed a change in flavour after the treatment with lindane, and seven of 20 people who ate cooked tubers reported a difference in flavour, which was considered objectionable by one.

SCHUDER (D. L.). **A Mite Infestation of the Honey Locust.**—*J. econ. Ent.* **43** no. 3 p. 397. Menasha, Wis., 1950.

Tetranychus ellipticus Garman was found defoliating *Gleditsia triacanthos* at Lafayette, Indiana, during the summer of 1949 ; the mites and their eggs were abundant in webs on the abaxial sides of the leaves. A spray of 1 lb. 25 per cent. parathion wettable powder and 1 lb. 50 per cent. parachlorophenyl parachlorobenzenesulphonate per 100 U.S. gals. water, applied to the more heavily infested of two trees on 19th August, had killed all the mites five days later, when the untreated tree showed a natural mortality of 37 per cent. Fresh leaves developed on infested trees in late August.

BROMLEY (S. W.). **Tests on Elm** *Scolytus* **1949.**—*J. econ. Ent.* **43** no. 3 pp. 397–398, 1 ref. Menasha, Wis., 1950.

In further tests at Stamford, Connecticut, in 1949 [*cf. R.A.E.*, A **37** 396] two young American elm trees [*Ulmus americana*] in pots were sprayed with wettable-powder suspensions of toxaphene and methoxy-DDT (methoxychlor), respectively, and caged in celluloid ; an unsprayed tree was similarly caged, and adults of *Scolytus multistriatus* (Marsh.) to a total of about 1,000 per cage were introduced every other day from 18th May to 13th June. The trees were exposed to the weather on 4th August, when all the beetles had been dead for several weeks. The unsprayed tree showed girdling by 1st June and was dead by 1st August ; it contained 42 feeding punctures. The tree sprayed with toxaphene showed 12 feeding punctures and about 40 per cent. leaf drop due to spray and insect injury, and that treated with methoxy-DDT showed no feeding punctures or spray injury and was alive and healthy in October. In the toxaphene cage, *Scolytus* adults survived for up to three days, *Eutetrapha* (*Saperda*) *tridentata* (Ol.) for 1–7 days and a small Elaterid for four days. The *Scolytus* adults died within 24 hours in the methoxy-DDT cage, but survived for several days in the untreated one. The results indicated that methoxy-DDT is promising and toxaphene inferior to DDT [*loc. cit.*] against *Scolytus*.

Owing to the early season in 1949, emergence of *S. multistriatus* at Stamford began about a month earlier than in 1948. It first occurred on 16th May in a cage in the sun and on 28th May in one in the shade, reached a peak on 12th June and finished on 13th July, whereas in 1948, emergence began on 11th June and reached a peak on 3rd July. In other localities in the same latitude as Stamford, emergence was even earlier, beginning on 7th May at New Haven, Connecticut, on 8th May at Millbrook, New York, and on 13th May at Westport, Connecticut.

CHANDLER (S. C.). **Forbes Scale as a major Pest of Peach.**—*J. econ. Ent.* **43** no. 3 p. 398. Menasha, Wis., 1950.

The use of DDT in dusts and sprays against various insects on peach in Illinois began in 1947 and became general in 1948. Its effects on *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.) and *Q.* (*A.*) *forbesi* (Johnson) are here described. *Q. perniciosus* had been shown by previous surveys to reach a high peak of infestation every third year, followed by a drop to a low level in the next year. This pattern was not repeated in 1948 and 1949, when 63 and 53 per cent. of the orchards, respectively, had moderate to severe infestations in some parts of them. *Q. forbesi* had previously been of no importance on peach, but examination in November 1949 of samples of scale insects from 11 heavily infested orchards in seven important peach-growing counties in southern Illinois showed that *Q. forbesi* was the only species in six of them, and

Q. perniciosus in two, while both species occurred in the remaining three. This increase of *Q. forbesi* on peach parallels its notable increase on apple within a year of the general inclusion of DDT in the apply spray schedule.

BROMLEY (S. W.). **Dragon Fly feeding on Cankerworms.**—*J. econ. Ent.* **43** no. 3 p. 398, 1 ref. Menasha, Wis., 1950.

In late May 1949, adults of *Tetragoneuria cynosura* (Say) were observed seizing larvae of *Alsophila pometaria* (Harr.) that were spinning down from trees at Monroe, New York, in great numbers. This dragonfly had been seen feeding in large numbers on swarming winged termites (*Reticulitermes flavipes* (Koll.)) in late May in 1913–15 at Southbridge, Massachusetts, and it has frequently been observed to attack mosquitos.

MASON (H. C.). *Chremylus rubiginosus* (**Nees**), **a Braconid Parasite of the Casemaking Clothes Moth.**—*Ann. ent. Soc. Amer.* **41** no. 1 pp. 28–40, 5 figs., 4 refs. Columbus, Ohio, 1948.

Chremylus rubiginosus (Nees), which has been recorded from a variety of hosts in Europe, a list of which is given, was obtained in October 1931 from larvae of *Tinea pellionella* (L.) collected from a wool warehouse in Columbus, Ohio. All stages of this Braconid are described, and an account is given of the way in which it was reared in the laboratory on larvae of *T. pellionella* obtained from a culture on raw fur. Groups of 15–20 larvae, ranging in size from less than half grown to practically full-fed, with a little raw wool or fur, were exposed in pill-boxes to 5–15 female parasites, usually for about 24 hours. The larval cases were then slit to allow observation of eggs and parasite development, the whole of which takes place externally on the host, but were kept closed between observations.

Life-history studies were carried out at various temperatures and relative humidities. At averages of 81°F. and 79 per cent. humidity, the egg stage averaged 1·4 days, the larval stage 4·5 days and the prepupal and pupal stages together 11·6 days. Total development of males and females averaged 17·4 days under these conditions, but required averages of 19 and 18·4 days, respectively, at 81°F. and 61 per cent. humidity, 22 and 20·9 at 81°F. and 43 per cent., and 29·1 and 28·9 at 71°F. and 61 per cent. The trend for faster development in females was significant in some cases. In a test on the effect of repeated examination on development, males and females reared at 74°F. and 47 per cent. humidity required 24·6 and 23·6 days, respectively, when examined three times a day and 22·2 and 22·6 when left undisturbed. The difference was significant in the case of the females ; males were too few for comparison. Emergence from parasitised material kept in a refrigerator at about 53°F. and high humidity for 105 or 165 days was very low.

The parasite generally paralysed the host larva before ovipositing, and eggs were usually deposited either on the body of the host or the inside of its case. As many as 30 eggs were found scattered over a single larva, either singly or in groups, 21 large parasite larvae were found on one host, and 6–7 adults commonly emerged from a single case. At 71°F. and 55 per cent. humidity, fertilised and unfertilised females lived for 7–14 and 4–20 days and deposited 0–27 and 0–33 eggs, with maxima of 9 and 7 eggs per day. At 89°F. and 41 per cent., they lived for 1–10 and 4–10 days and laid 0–30 and 0–21 eggs, with maxima of 10 and 9 per day. At temperatures of 81, 72, and 50°F. and relative humidities of 61, 59 and 60 or more per cent., respectively, the average lengths of life were 8, 9·7 and 13·9 days for males and 11·4, 13·8 and 71·7 days for the females. The differences between males and females were highly significant.

Adults paired readily in confinement. Fertilised females gave rise to 79 per cent. female and 21 per cent. male adult progeny and unfertilised females to males only.

KROMBEIN (K. V.). **Liberation of oriental Scolioid Wasps in the United States from 1920 to 1946 (Hymenoptera: Scoliidae, Tiphiidae).**—*Ann. ent. Soc. Amer.* **41** no. 1 pp. 58–62, 3 refs. Columbus, Ohio, 1948.

Since 1920, numerous examples of two species of *Campsomeris* and 12 of *Tiphia* from the Far East have been liberated in the north-eastern United States for the control of the introduced Lamellicorns, *Popillia japonica* Newm., *Anomala orientalis* Waterh., *Aserica* (*Autoserica*) *castanea* Arr. and *Serica peregrina* Chapin [*cf. R.A.E.*, A **30** 51, etc.]. In this paper, the author records the years in which each species was first liberated in the different States, with the pest it was intended to control and available data on field recoveries. The only species that have been liberated since 1933 are *T. castaneaevora* Parker (a parasite of *A. castanea*), *T. popilliavora* Rohw., *T. sternata* Parker and *T. vernalis* Rohw., and the only ones that have become established are *T. popilliavora* and *T. vernalis*, which are important factors in the control of *P. japonica*, *T. asericae* Allen & Jaynes, which was liberated against *A. castanea* and *S. peregrina*, and possibly *T. sternata*, which was liberated against *S. peregrina*.

WILLE (J. E.), PÉREZ ALCÁZAR (A.) & JOHANSON G. (G.). **Informe sobre los resultados obtenidos en la temporada de 1946–47 en el control de los insectos de la alfalfa por medio del insecticida DDT.** [Report on the Results obtained in the Season of 1946–47 in the Control of Insects attacking Lucerne with the Insecticide DDT.]—*Inf. Estac. exp. agríc. La Molina* no. 66, 16 pp. Lima, 1947.

The most serious pests of lucerne in Peru have for a number of years been *Epinotia opposita* Heinr., which bores in the terminal shoots, preventing their development, and also webs together and feeds on the leaves, and *Anticarsia gemmatalis* Hb., which entirely defoliates the plants. Either is capable of destroying a whole field of lucerne. In addition, great damage has of recent years been caused in the coastal valleys of the south by larvae of another moth, identified in Washington as *Dichomeris rustica* (Wlsm.), which also feed on the shoots and leaves, leaving nothing but the bare stalks. In view of the serious losses caused by these three pests, two preliminary tests on their control with DDT sprays were made in Ite in 1946–47. The sprays were prepared from a powder containing 50 per cent. DDT. In the first test, the sprays were applied in November to lucerne 11–21 days after sprouting and excellent control was obtained, even with a single application of 0·125 per cent. DDT. The larvae proved somewhat more resistant to the insecticide than the adults, but only 25–30 per cent. of the shoots were damaged 24 days after treatment. The best results were given on the younger plants. In the second, the lucerne was sprayed on one of various dates between February and April, and the same low concentration again gave excellent control, adults and larvae usually disappearing from the field after 8 days, though some larvae were again present after 16 days. Spraying with 0·1–0·5 per cent. DDT at intervals of 15–20 days, beginning 15 days after sprouting, is recommended.

Sauer (H. F. G.), Duval (G.) & Falanghe (O.). **Combate à broca do café e a possibilidade do emprêgo de inseticidas.** [The Control of the Coffee Berry Borer and the Possibility of using Insecticides.]—*Biológico* **13** no. 12 pp. 205–214. São Paulo, 1947.

Seixas (C. A.). **Contrôle químico da broca de café.** [Chemical Control of the Coffee Berry Borer.]—*T.c.* pp. 215–228.

Lepage (H. S.), Giannotti (O.) & Orlando (A.). **Esclarecimentos sôbre a composição do " RB 1018," novo inseticida derivado orgânico do fósforo.** [An Explanation of the Composition of RB 1018, a new organic Phosphorus Insecticide.]—*Op. cit.* **14** no. 1 pp. 17–18. 1948.

The first two of these papers contain accounts of tests in São Paulo, Brazil, in 1947 on the control of *Stephanoderes* (*Hypothenemus*) *hampei* (Ferr.) on coffee. Most of the work was done with DDT and BHC (benzene hexachloride), but both include the results of laboratory tests with RB 1018. This is stated in the third paper to be a diethyl paranitrophenyl thiophosphate of Brazilian manufacture also known as Rhodiatox and almost certainly identical with Thiophos 3422 [parathion].

In the work described in the first paper, spray deposits of DDT, BHC and RB 1018 were shown to be toxic to adult beetles in the laboratory. BHC applied at 0·025 per cent. γ isomer prevented all entry into treated berries, while DDT permitted some incipient entries at 0·5 per cent., though all the beetles found five days later were dead, and permitted some survival of beetles that entered the berries at 0·25 per cent. Fumigant action may have contributed to the effectiveness of the BHC. In field tests, all infested berries were first removed from the trees. A spray of 0·1 per cent. DDT gave good results in a preliminary experiment on a single tree in June, and 0·2 per cent. applied in October to trees under which infested berries were placed to ensure the presence of numerous beetles permitted only 7·5 per cent. damaged berries in 15 days, as compared with 26·7 per cent. in the controls, and greatly reduced the percentage of damaged berries containing living beetles. In a third test, also in October, in which infested berries were placed beneath the trees on two occasions, 0·5 per cent. DDT was compared with 0·02 per cent. γ BHC. The percentages of berries attacked after 15 days were 3·3 and 1·6, respectively, as compared with 29·7 for no treatment, and BHC also gave the lowest percentage of berries containing living beetles. A further count made after 25 days showed that the percentages attacked were then 4·7 for DDT, 2·27 for BHC and 38·75 for no treatment, but DDT had resulted in a slightly lower percentage of galleries containing living beetles than BHC. These figures were based on fruits in a suitable stage for attack, and these represented only about 20 per cent. of the total crop.

In a second paper, the author records laboratory tests showing that dusts of BHC and RB 1018 were highly toxic to adults of *S. hampei* when applied to fruits into which they had begun to penetrate or when the beetles were confined with dusted leaves. DDT was less effective in both types of test. Field experiments were carried out in October and November, but the results of only some of them were available at the time of writing. In one, dusts of crude BHC to give 2 per cent. γ isomer, 5 per cent. DDT or a mixture of both were applied with a power machine four times between 28th October and 17th November. Rain fell on several days in this period. Five days after the first application, the percentages of galleries abandoned after having been begun were higher on treated than on untreated trees, and examination of berries at picking on 22nd November showed that the percentages free from damage and (in brackets) abandoned were then 69 (24·3), 80 (7) and 75 (17), respectively, as compared with 43 (14·3) for no treatment. The average numbers of living beetles per berry in dried fruits remaining after harvest were less than half as great on trees that received either of the BHC dusts as on the controls. The reduction

was less for DDT alone. BHC dusts containing 1 and 0·5 per cent. γ isomer were then compared. A single application was made on 20th November, and berries were examined on 4th December. The percentages containing dead beetles, living beetles and abandoned galleries were 27, 33 and 38 for 1 per cent. BHC, 16·5, 31·5 and 52 for 0·5 per cent., and 5·5, 63 and 31·5 for no treatment. It is concluded that BHC is promising for the control of the beetle and more effective than DDT.

LAL (K. B.). **The Identification of** *Bracon hebetor* (**Say**) **and** *B. brevicornis* (**Wesmael**).—*Indian J. Ent.* **8** pt. 1 pp. 85–88, 12 refs. New Delhi, 1947.

Bracon hebetor Say and *B. brevicornis* Wesm. have been recorded from various Lepidoptera in different parts of India [*R.A.E.*, A **24** 483 ; **28** 512 ; **32** 304], but in view of their similarity there is some doubt as to whether both species occur there or not. Specimens reared at the Lac Research Institute in Bihar and at New Delhi were examined in 1939 in an attempt to elucidate this point. Muesebeck [**13** 411] separated the two species mainly on the number of segments in the antennae, there being 13–15 in females and 18–23 in males of *hebetor*, and 17–19, rarely 16, in females and 20–27 in males of *brevicornis*. He also stated that the abdomen is seldom punctate in *hebetor* and nearly always so in *brevicornis*. All the Bihar specimens showed typical *hebetor* characters. One batch of specimens from New Delhi, all reared from a single pair of parents in *Antigastra catalaunalis* (Dup.) on *Sesamum orientale* (*indicum*), included many that were typically *brevicornis* but also some females with antennae having 16, 20 and 21 segments. Four specimens from this lot were examined by G. E. J. Nixon, who identified two as *B. stabilis* Wesm.*, a species very closely allied to *B. brevicornis*, and the other two (a male with 20 antennal segments and a female with 14) as *B. hebetor*. Another group from New Delhi included females reared from *Earias* sp. with antennae that had 15 or 16 segments and were of typical *hebetor* shape, males from the same host in which the number of antennal segments was characteristic of *hebetor*, but the abdomens were punctate, and a female from *Heliothis armigera* (Hb.) with antennal and other characters typical of *brevicornis*.

The data indicate that both species show considerable variations in structural features as well as in colour and other body markings ; furthermore, some hosts, such as *A. catalaunalis*, *Adisura atkinsoni* Moore and *Corcyra cephalonica* (Staint.), appear to be common to both, though some host records may be based on mistaken identification of the parasites. The author is inclined to think that *hebetor* and *brevicornis* may prove identical, with perhaps biological or geographical races, but considers that they are for the present best retained as distinct species separated in accordance with Muesebeck's key, though this should be modified to include a range of 16–21 antennal segments in the female of *brevicornis*. Both species apparently occur in northern India, with a possible preponderance of *B. brevicornis* in the Delhi area and of *B. hebetor* in Bihar and areas to the east of it ; incidence may depend, at least in part, on the presence of preferred hosts.

MATHUR (R. N.). **Notes on the Biology of some Mantidae.**—*Indian J. Ent.* **8** pt. 1 pp. 89–106, 12 figs., 7 refs. New Delhi, 1947.

This paper is based on observations in irrigated plantations of *Dalbergia sissoo* in the Punjab in 1937–40, and in plantations of teak (*Tectona grandis*)

*In fact, Nixon identified these two specimens as "*Bracon* (*Habrobracon*) sp. near *stabilis* Wesm." and no indication was given by the sender that they were reared from the same female as the other two.—*Ed.*

in Coorg in 1941–42 and on a few records at Dehra Dun, United Provinces. It contains notes on the distribution and bionomics of 26 species of Mantids. Of 12 that occurred in the *Dalbergia* plantations, *Creobroter urbanus* (F.), *Deiphobe incisa* Werner, *Hierodula* (*Parhierodula*) *coarctata* Sauss. and *Schizocephala* sp. were the commonest, and with *Hierodula* sp. and *Tenodera superstitiosa* (F.), were observed to prey on *Plecoptera reflexa* Gn., which defoliates *Dalbergia*. The first three also attacked *Dichomeris eridantis* (Meyr.), and *Deiphobe incisa* and *H. coarctata* preyed on *Tephrina disputaria* (Gn.). Of 11 species recorded in the teak plantations, *Odontomantis* (*Euantissa*) *ornata* (Werner), *Gonypeta punctata* (Haan), *Leptomantis indica* G.-T. and *Tropidomantis guttatipennis* Stål preyed on *Hapalia machaeralis* (Wlk.), which defoliates teak, and the last also fed on *Hyblaea puera* Cram. ; *E. ornata* and *T. guttatipennis* were the most abundant species. The importance of these Mantids in control is unknown, but adults of different species ate 1–3 larvae per day in captivity.

During July–August 1938, three batches of nymphs of *Deiphobe incisa*, totalling 6,235 individuals, were sent by post to a *Dalbergia* plantation where the presence of this species was doubtful. Liberations were made at points where *Plecoptera reflexa* was abundant, and eggs from which the nymphs had hatched were recovered in May, July and August 1939. About 200 nymphs and 47 egg masses were liberated in another plantation heavily infested by *P. reflexa* on 25th July 1939. The egg-masses were placed in small tin containers punched with holes that were hung on the branches, and hatching under these conditions was satisfactory. Particulars are also given of numbers and dates of release of egg-masses, adults and young nymphs of *Hierodula coarctata*, of which small numbers, including some reared in the laboratory, were liberated in a plantation of *Dalbergia* in 1938 and 1939.

Trehan (K. N.). **Biological Observations on** *Trypanea amoena* **Frfld.**—*Indian J. Ent.* **8** pt. 1 pp. 107–109, 6 refs. New Delhi, 1947.

Trypanea amoena (Frauenfeld), the adult, larva and puparium of which are briefly described, attacked flowers of marigold at Lyallpur, in the Punjab, in 1939, interfering with the opening of the buds and causing the flowers to become malformed. The infestation was observed in March and April, and 251 larvae and pupae were taken from 615 malformed flowers, 40·8 per cent. of which were infested. Both larvae and puparia were almost embedded in the thalamus at the base of the disk florets, and up to nine occurred in individual flowers. As a result, the ray florets became clustered at the middle, tending to form a cone. The larvae were almost full grown and were less numerous than the pupae. Adults were not seen in the field, and some that emerged in the laboratory could not be induced to breed. Other composite flowers growing with the marigolds were not attacked. This Trypetid was not seen in March–April of the following year, but in November, 29 puparia and three fully grown larvae were obtained from 529 affected chrysanthemum flowers.

Some of the larvae were parasitised by two undescribed Chalcidoids, one being a Torymid of the genus *Dimeromicrus* and the other a Pteromalid of the genus *Habrocytus*.

Mohammed Qadiruddin Khan. **Life-history and Bionomics of Castor Semi-loopers in Hyderabad (Deccan).**—*Indian J. Ent.* **8** pt. 1 pp. 111–115, 4 refs. New Delhi, 1947.

The most important pests of castor (*Ricinus communis*) in Hyderabad are *Achaea janata* (L.) [*cf. R.A.E.*, A **24** 371] and *Parallelia algira* (L.), all stages of both of which are briefly described, including four colour varieties in the

larvae of *A. janata*. Both species also feed on rose, pomegranate, *Bauhinia*, *Euphorbia*, *Zizyphus* and *Ficus bengalensis*. Observations on the bionomics of these moths have shown that they have 5–6 overlapping generations a year. The larvae feed on the leaves, and most of the damage is caused by the second and third generations in August and September, though the fourth is injurious in October and November in some areas. The eggs of both species hatch in 2–3 days and the durations of the larval and pupal stages are about equal, complete development requiring about a month in June–August and about seven weeks in February–March. The eggs of both are parasitised by *Trichogramma*, and the larvae by *Microplitis maculipennis* (Szépl.) and *Euplectrus* sp., while larvae of *A. janata* are also parasitised by *Rogas* (*Rhogas*) sp. *M. maculipennis* completes its life-cycle in about a week.

NASIR (M. M.). *Chrysopa cymbele* **Banks and its two new Varieties.**—*Indian J. Ent.* **8** pt. 1 pp. 119–120, 5 figs. New Delhi, 1947.

Chrysopa cymbele Banks was observed preying in large numbers on *Bemisia tabaci* (Gennadius) and *Empoasca devastans* Dist. in cotton fields in Lyallpur (Punjab). Examples collected in 1939 and 1940 included two new colour varieties here described as *fasciata* and *a-fasciata*, as well as the typical form.

Short Notes and Exhibits.—*Indian J. Ent.* **8** pt. 1 pp. 131–132, 1 fig. New Delhi, 1947.

V. Prabhaker Rao (pp. 131–132, 1 fig.) records that egg-masses of *Icerya purchasi* Mask. on *Casuarina* in Mysore State were attacked by larvae of *Euzophera cocciphaga* Hmps. [*cf. R.A.E.*, A **17** 651], which fed and pupated within the ovisacs of the Coccid. They were numerous, and appeared to exert considerable control.

R. N. Singh (p. 132) states that the date of hatching of eggs of the mango mealybug, *Drosicha stebbingi* Green, varies greatly from year to year and place to place and is influenced chiefly by the temperature and humidity of the soil, which in turn are affected by the date of the monsoon rains and by cultivation. If the humidity and temperature of the soil decrease gradually after the rainy season, hatching may take place in November, but late monsoon rains and winter showers delay it considerably. Digging the soil cools and dries it quickly, and if it is done in November, when embryonic development is complete, it hastens hatching and facilitates the emergence of the nymphs from the ground. Digging during or soon after the monsoons, however, when the eggs are in an early stage of development, may destroy many of them. A similar effect has been noted in the case of eggs of the apple root borer, *Dorysthenes hueglii* (Redt.), almost all of which are killed by digging when they are in an early stage of development. It is suggested that digging in mango plantations soon after the rains to destroy the undeveloped eggs and again about the middle of November to hasten hatching of the surviving eggs at a time when there is little food for the nymphs may minimise damage by *D. stebbingi*.

FRAPPA (C.). **La question acridienne à Madagascar.**—*Agron. trop.* **2** no. 3–4 pp. 125–149, 10 figs., 16 refs. Nogent-sur-Marne, 1947.

Locust outbreaks that have occurred in Madagascar during the past 50 years are reviewed, and accounts are given of the bionomics of *Nomadacris septemfasciata* (Serv.) and *Locusta migratoria capito* (Sauss.), the two species concerned; much of the information given has already been noticed [*R.A.E.*, A **18** 27, 103, 565; **24** 236; **27** 14, 543]. Control of the outbreak of *L. m. capito* that began in 1939 [**28** 304] was hindered by the shortage of materials

and equipment resulting from wartime conditions and it had extended over almost the whole island by the end of 1946. The situation was aggravated by an increase of *N. septemfasciata* in the south in 1945.

Eggs of *N. septemfasciata* are deposited in groups of about 50 in October–November. The preferred oviposition sites are on light soil covered with tender vegetation, situated near streams or marshes and stands of *Phragmites communis*, but not liable to flooding. The eggs hatch after 30–40 days, and the adults appear between 20th April and 15th May, but do not become sexually mature until August or September. During the cold season, the adults remain on the semi-desert plateaux where they feed mostly on pasture grasses and move about very little, but at the onset of the hot season, they form large flying swarms, sometimes in conjunction with *L. m. capito*. Both adults and hoppers have been found to cause great damage to cereal and leguminous crops and other cultivated plants [*cf.* **24** 236], notably in valleys and on the plains in the south ; the varieties of sweet potato cultivated in the south appear to be the only plants of economic importance that are not attacked. The origin of the large flying swarms observed in Madagascar is unknown ; they may arise from abnormal multiplication under favourable conditions, but migration from Africa cannot be excluded. Swarms have been reported near the island of Juan de Nuova by the pilots of aircraft flying between Madagascar and Mozambique.

Laboratory and field experiments have shown that the eggs of *L. m. capito* cannot develop at temperatures below 16°C. [60·8°F.] and under such conditions remain in diapause in the soil for several months. The diapause is broken by a combination of high temperature and soil humidity [*cf.* **26** 416], which, in the field, is provided by the first rains of the hot season [**27** 14], but temperature alone is not sufficient. The duration of the egg stage ranges from 15 days during November–March in the rainy season in the south to several months during April–September, in the cold dry season at Tananarive. A temperature of 22°C. [71·6°F.] is necessary for successful moulting. In the laboratory, the hopper stage occupied 33–45 days at a constant temperature of 27°C. [80·6°F.] and 21–24 days at 33°C. [91·4°F.]. At temperatures above 40°C. [104°F.], the hoppers feed little and seek shade. Control rearing in the open air indicated that the rate of development is considerably modified by daily fluctuations in temperature. These findings explain the absence of any important nymphal development during May–September on the high plateaux and why three generations can develop in the warmer regions during the period required for two elsewhere. Field observations showed that the onset of the winter diapause of eggs of the last generation is determined chiefly by the fall in temperature in July and August. When the rains start in good time and are prolonged so that the vegetation remains green in April–May, development can continue for eight or nine months and three or four generations can be produced.

The expansion of the work of the control organisation [**28** 304] in recent years and the methods employed by it are discussed. The cost is heavy in comparison with the resources of Madagascar, and suggestions are made for rendering the work more economic.

ALIBERT (H.). *Phytolyma lata* **Scott var.** *fusca* **var. n., Psyllidae, vivant sur iroko** (*Chlorophora excelsa*). RISBEC (J.). **Note au sujet des parasites du** *Phytolyma lata*.—*Agron. trop.* **2** no. 3–4 pp. 165–169, 3 figs. Nogent-sur-Marne, 1947.

Alibert describes a dark variety of *Phytolyma lata* (Wlk.) from adults of both sexes found on *Chlorophora excelsa* in the Ivory Coast [*cf. R.A.E.*, A **36** 68], names it var. *fusca*, n., and gives brief descriptions of the nymphs.

The Psyllid causes the formation of galls on the plants. Many of the young nymphs were parasitised by Chalcidoids, which oviposit within the galls, 50 per cent. of the latter being attacked at the end of October.

Risbec states that the parasites submitted to him comprised two Eulophids, one of which he describes from both sexes as *Aprostocetus phytolymae*, sp. n., and an imperfect female specimen of an unidentified Encyrtid, which he also describes.

RISBEC (J.). **Les charançons nuisibles aux patates douces.**—*Agron. trop.* **2** no. 7–8 pp. 375–398, 23 figs., 57 refs. Nogent-sur-Marne, 1947.

This paper includes a review of the distribution, bionomics and control of *Cylas formicarius* (F.) and *Euscepes postfasciatus* (Fairm.) (*batatae* (Waterh.)), with brief notes on other weevils that attack sweet potatoes and some species of *Cylas* that occur in Senegal or Madagascar of which the bionomics are unknown. Most of the weevils are briefly described and a key is given to the species of *Cylas* that occur on sweet potato or in Senegal. The species of this genus other than *C. formicarius* that are known to attack sweet potato are *C. femoralis* Faust in Liberia [*R.A.E.*, A **7** 277], *C. puncticollis* Boh. (*compressus* Hartm.) in Uganda [**16** 63] and possibly in Southern Rhodesia [**20** 556], and *C. puncticollis* and *C. cyanescens* Boh. in Senegal. *C. puncticollis* has also been recorded in the Belgian Congo [*cf.* **28** 311]. The author has reared several parasites from *C. puncticollis* in Senegal; these comprise *Rhaconotus menippus* var. *africanus* Nixon, and species of *Bracon* (*Microbracon*), *Bruchobius*, *Macreupelmus* and *Eurytoma*. There are two species of *Bracon*; the adults of one of them are described, while the other is allied to *B.* (*M.*) *brevicornis* Wesm. A species of *Cheiloneurus*, of which only one specimen has been obtained, may be a hyperparasite of *Cylas*.

The remaining sweet-potato weevils are *Euscepes porcellus* Boh. in Jamaica, Porto Rico and Cuba [**6** 414; **7** 56] and Guadeloupe, *Alcidodes* (*Alcides*) *convexus* (Ol.) in Madagascar [**18** 594], *Peloropus batatae* Mshl. in Uganda [**17** 349] and *Palaeopus costicollis* Mshl. (*dioscoreae* Pierce) in Jamaica [*cf.* **6** 209, 254; **8** 236].

The paper concludes with a list of various other beetles (including a few weevils) that have been recorded on sweet potato in the field or in store; many of them are polyphagous.

MORETON (B. D.). **Guide to British Insects. An Aid to Identification.**—$7\frac{1}{2} \times 5$ ins., vii+188 pp., 96 figs., $7\frac{1}{2}$ pp. refs. London, Macmillan & Co. Ltd., 1950. Price 8*s.* 6*d.*

This book is intended for farmers and others who need to identify insects without going into much scientific detail. It contains a key, based mainly on morphological characters, to the adults and immature stages of 23 orders of insects represented in Great Britain. This is preceded by introductory notes on the general morphology and life-history of insects, and followed by a systematic survey of the various orders, giving information on the means whereby they can be recognised, their general morphological characters and, in some cases, those of lower groups, and their life-history, habits and food, exemplified by typical species, many of which are of economic importance. A list of books to which reference should be made for more precise identifications and a short glossary of technical terms are appended.

Reckmann (G.). **Kampf dem Fichtenborkenkäfer** (*Ips typographus* **L.**) **bei Massenvermehrung.** [The Control of the Spruce Bark-beetle (*I. typographus*) during an Outbreak.]—8½×6 ins., 218 pp., 38 pls., 25 graphs, 2 maps, 2 diagrs., 7 pp. refs. Berlin, Deutscher Zentralverlag [1950]. Price 12·50 *DM*.

This book was written to arouse interest in the control of the numerous outbreaks of *Ips typographus* (L.) that have occurred in the spruce forests of central Europe since the end of the war. The author was placed in charge of large-scale operations against an outbreak in Sachsen-Anhalt, Germany, at the end of August 1948, and gives details of the work done up to the end of June 1949. The greater part of the book consists of discussions of the organisation of such a campaign, the various methods of control available and the costs involved, based on the actual work done and recent European literature on the subject. The outbreak in Sachsen-Anhalt was the result of neglect and damage during the war years coupled with the hot dry summer of 1947, which favoured the development of the bark-beetle but was detrimental to the trees ; infestation, which had spread slowly in 1945 and 1946, then increased greatly, so that by mid-1949 stands totalling nearly 20 sq. miles in area were affected. Trees 60 years old or more suffered most. Numerous observations on the bionomics of the beetle are recorded. Except at the edges of stands, the crowns of the trees became infested before the lower parts. Migration occurred mostly by crawling, and numerous beetles overwintered in the litter or soil in many places [*cf. R.A.E.*, A **38** 466], even though infested trees had not been felled. Overwintering in stumps also occurred in felled areas. In 1947, three generations of the bark-beetle were produced at the lower altitudes and double broods commonly occurred, but in 1948, there were not more than two generations and double broods were less frequent.

Control measures are reviewed at length [*cf.* **38** 92–93], notably the strategy of the arrangement of trap-logs and the number required to absorb a given population of emerging beetles. The trap-logs should never be scattered indiscriminately [*cf.* **38** 145], and the number required varies from about 30 to 100 per cent. of the number of infested trees, according to the degrees of infestation. Exact calculation is held to be impracticable [**38** 88]. Standing trap-trees are not recommended. Treatment of trap-logs with poisonous sprays or dusts [*cf.* **38** 144, 164] is most important, and the value of different materials in this connection is discussed. Many, including DDT, benzene hexachloride and arsenicals, were used with good effect, and the treatment of infested trap-logs with diesel oil was particularly successful. A useful auxiliary measure suitable for less skilled labour was to hammer the logs with large mallets as soon as the beetles had entered them.

The book is furnished with numerous statistical data and graphs and illustrated with original photographs of the work.

Papers noticed by Title only.

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